THE HEATING AND VENTILATING MAGAZINE

VOL. VI., NO. 11 NEW YORK, NOVEMBER, 1909 $1.00 a year, 10 cents a copy

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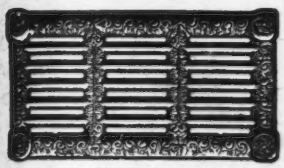

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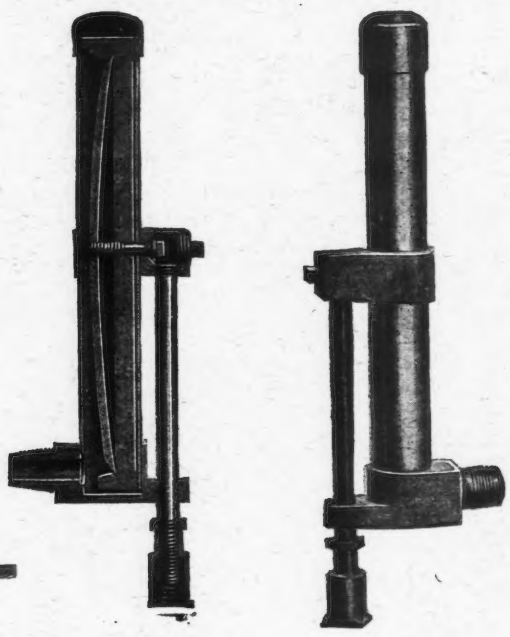

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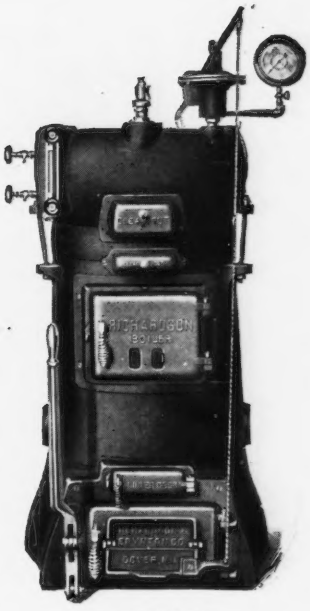

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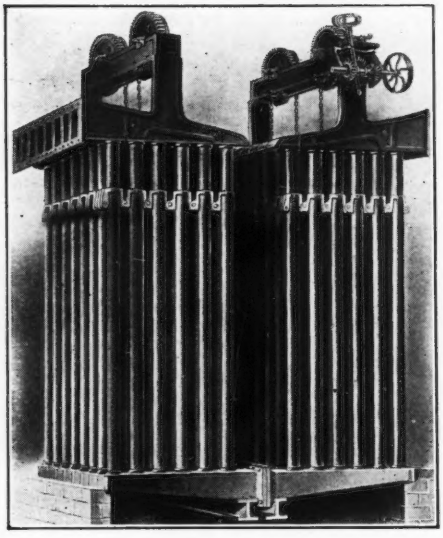

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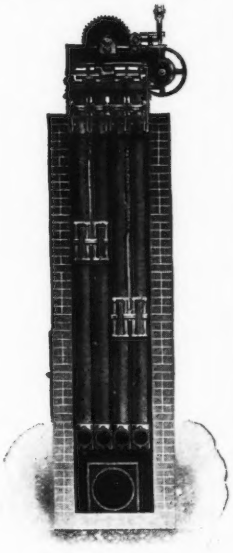

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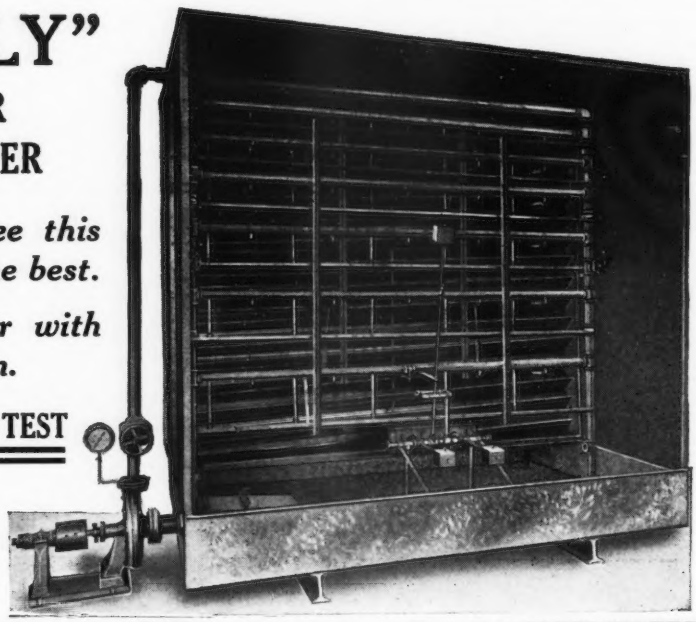

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The Heating and Ventilating Magazine

VOL. VI No. 11

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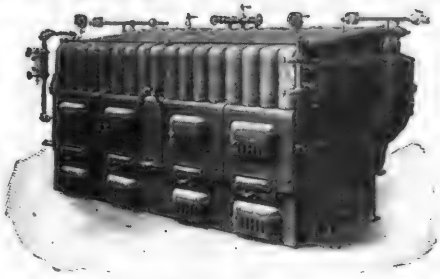

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THE HEATING AND VENTILATING MAGAZINE

1123 BROADWAY NEW YORK NOVEMBER, 1909

Steam Heating in Connection With Central Stations

BY PAUL MUELLER

(Concluded from October issue)

As it is usually considered advisable for electric lighting companies to leave interior work to local jobbers, and not shoulder the responsibility for its later satisfaction, so is it advisable for the steam heat company to go no farther than installing service, connect it up, and install meter. The invariable result, if interior work is done, will be innumerable telephone calls to "turn on more heat; we are freezing!" while if not done the company assumes no responsibility for their consumer's system. Before the steam is turned on to the consumer it is essential that all of his system be carefully inspected.

If on a flat rate, all piping should be covered, or else included in the total radiation on which charge is based. On meter, especial care should be taken to point out to the consumer all things which will tend to increase the steam necessary to heat building or house and size of bills as well, or cause lack of steam. Both the above being usually due to too much or too little radiation, bare pipes, or poorly installed systems.

If these faults are clearly pointed out to him in advance, and he is requested to fix them and does not, he can be given to understand no complaints for poor service or excessive bills will be later considered. Many complaints are thus saved, and after one or two bills the consumer speedily proceeds to have a local steam fitter carry out the company's original suggestions.

ADVANTAGES OF CENTRAL STATION SERVICE

The average new customer will expect to be able to heat his house with district steam at the cost of his previous yearly coal supplies. If he remodels the system in his house to a good, correctly installed atmospheric system, he may come somewhere near it if he formerly used a hot air furnace or possibly an indirect steam system. After a season or two of use he will appreciate the many other advantages of city steam with which actual experience was necessary to show him its value. Some of these advantages frequently overlooked are cited below:

1. In a new house or building no boiler is required, and if a hot water system had been considered, a saving of about 40% in the amount of radiation necessary to install would be accomplished.

2. With no boiler the danger of boiler explosion and trouble of boiler inspection disappears, and in some cases a lower rate of fire insurance has been obtained.

3. Increased cleanliness about the house, cellar, and grounds, as there is no coal and ash dust to blow about.

4. No repairing of boiler, or boiler to give out in the middle of winter, and any troubles the customer does

have are shouldered onto the steam heating company, who employs competent men to take care of them.

5. Janitor service greatly reduced, if not entirely done away with.

6. Steam is always there, day and night, and always ready for use when required, and an even temperature can be maintained at all times.

Competition with natural gas has been met with in some parts of the State, and even with gas at 30c. per 1,000 ft. the district steam came out ahead, for again there is no boiler and greatly reduced danger.

EACH INSTALLATION TO BE WORKED OUT AS AN INDIVIDUAL CASE

The successful and most economical operation of a power house using its exhaust steam for heating is a thing that has to be carefully worked out for each individual case. The point aimed at, of course, being the output of both steam and electricity as cheap as possible. The demand of one must be balanced against the demand of the other, and a happy medium arrived at by operating only the equipment best suited to the conditions, with no aid or as little as possible from live steam. A good illustration of this follows:

An electric light plant also furnishing steam for heating purposes was operating a winter day with thermometer 10° above zero. Two engines were running which by reason of the electric load developed 200 H.P., and necessitating the use of a certain amount of live steam to keep the pressure on the steam mains constant. A third engine was started and a portion of the electric load transferred to its generator. Seemingly strange, the pressure at once increased on the steam mains, and one boiler could be shut down. This plant also demonstrates that they use more coal when their electric load is lightest and live steam has to be resorted to, than they do when carrying the peak.

BACK PRESSURE ON ENGINES PROFITABLE

The matter of back pressure on engines should here be taken up. From the experience gained at Erie, Pa., during the last ten years in the heating business, it has been found that the back pressure is the most profitable load the engines carry. Ten years ago a man that attempted to operate a high speed engine maintaining a back pressure of any amount in excess of 5 lbs., would speedily have his reputation as an engineer at stake; but to-day engines are operated in one plant where the initial pressure is 150 lbs. with 35 lbs. back pressure. Furthermore, at the present time you can place an order for an engine which the builders will guarantee to successfully operate at a back pressure of 20 lbs. and at the same time develop a full load.

The value of the back pressure load of the engines at Erie, Pa., is rated so high that I claim an electric light plant furnishing steam heat can afford as a matter of economy to run simple engines belted or direct connected to generator, and dissipate or throw away through the medium of a large rheostat, into a stream of water, the electric output of said generator to use the exhaust steam for heating purposes. Furthermore, that this is being done profitably at that station, and it is a common occurrence to start an engine with but a fraction load in order to get exhaust steam to turn into the mains.

This certainly is a very broad statement in regard to the merits of exhaust steam versus live steam, and I hope we can have a very interesting discussion later on this point, and there will be some light thrown on the theory involved. There is no doubt that the point has been reached where we have the right to wonder whether it really is the steam, or it is the electricity that is the by-product.

Methods of Heating Garages

Considering first the matter of heating, the problem is to keep the storage place at a reasonable uniform temperature throughout all weather changes, and this without danger of igniting the vapors which are so much to be dreaded.

The temperature which is to be maintained, with which the choice of method to a large extent varies, depends chiefly on the fancy of the owner. The only absolute requirement is that the temperature shall never get low enough to freeze the water in the tanks and pipes. This is essential, not simply because of the dangers attendant upon freezing the cooling water of petrol cars or the boilers of steamers, but also on account of the unpleasantness of working about cold machinery and the difficulty of filling grease cups and lubricators when the oil is congealed. Besides, if kept in a cold stable, the bearings of a car become so stiff as to use up considerable extra power when run again, while if they are kept reasonably warm when the car is standing, they will not stiffen up while on the road, except in extreme weather. Moreover, certain types of carburetors give trouble when cold.

NO OPEN FIRE

Its inflammable character and the fact that petrol vapor is heavier than air, make it imperative that the heater be one which contains no open fire—at least, within the walls of the building. As it is often necessary that petrol be handled in the garage, the precautionary measures must consist essentially of placing the fire where the vapor cannot come in contact with it. This may be done by locating the source of heat in another building or in a compartment of the same building, which is partitioned off by fireproof walls and having its entrance from the outside only.

Basement boiler and furnace rooms, as used in other buildings, are out of the question, says a writer in the *Columbus* (O.) *News*. And in this connection it may be noted that the use of basement floors in a garage is always unsafe, unless special ventilation is provided for removing the heavy gases which accumulate there. The not uncommon practice of locating shops and battery charging rooms in ill-lighted, unventilated sub-floors is extremely dangerous, both on account of the fire risk and because of the unhealthy conditions which are to be found there.

The heating of any building may be accomplished by either direct or indirect radiation. It may have its own heating system, or it may be one of a system of several deriving their heat from a central plant, just as the several floors of a building may be heated by a single furnace. As to the method of distributing the heat in various rooms, this may be done by placing the radiating surface directly in the room and heating it by circulating through it some conductor, like hot water or steam, or the radiating surface may be outside the room and the air heated by being passed over it and then to the room by pressure or induction.

The latter plan introduces a combined heating and ventilating system. Evidently this method is particularly applicable to motor houses, as it eradicates not only all fire, but all heated surfaces which might cause the charring of dry wood or waste, and the ignition of the petrol vapors in an indirect way. But this method, involving, as it does, the installation of fans and heating stacks, is too expensive for simple use except in elaborate establishments. It is a comparatively simple matter, in many cases, to use steam or hot water heat, piping the supply from a neighboring building. This is applicable to many of the small private garages.

SMALL HEATERS EMPLOYED

Where it is necessary to heat the building independently there are several satisfactory methods which may be employed. This consists of a small heater, using oil, or preferably gas, placed in a metal sheathed compart-

ment on the outside. Within, on the adjacent wall, is placed a combined radiator and expansion tank of simple construction. On the same principle any small heater, as is used for greenhouses, for instance, may be employed, the coils being laid upon the more exposed walls and under the windows.

A simplification of this is to build the compartment sufficiently large to enclose a stove, and to place a sheet iron bell over the latter leading to a register in the wall. The inside of this "lean-to" erection must be lined with sheet metal, and a considerable air space allowed between the lining and the sheathing to prevent undue leakage of heat. The efficiency of such a method would depend largely on the construction of the building and the amount of leakage of heated air through the roof and walls, which would easily be reduced to a practical minimum, and the system thereby made very effective.

VENTILATION NECESSARY

Turning to the subject of ventilation, it will be seen that the capacity of the ventilators must be sufficient to remove any excess of vapor which may be caused by unlooked-for conditions in the car. Heated air, of course, rises. The fact must be the basis of all considerations of the ventilating problem, and in many systems it is used to induce a circulation of air from all parts of the room to one at the top. But, as already stated, petrol vapor is heavier than air, and must always tend to stay near the floor, except when stirred by a draught. Therefore the air outlet in a garage must be at the bottom of the room instead of at the top.

ARE FLIMSILY BUILT

Many motor houses especially the small ones, are so flimsily built, and have so much free ventilation unavoidably, that no special provision is considered necessary. But as a safeguard against emergencies, particularly at night, when a flooding carburettor or a leaky pipe joint may be the means of distributing petrol over the floor, absolutely certain ventilation must be secured.

The complete indirect method of heating and ventilating may be applied to large or expensive garages with the best of success; but for the small structure a very simple method, which should be effective in clearing the danger zone within a few inches of the floor, is as follows: An ordinary stove pipe is run up one of the walls of the building and projecting through the roof is topped with a ventilating cap. At the bottom it is left open a few inches above the level of the floor.

Part way up the wall it is heated by close contact with the radiator, or it may be jacketed and heated by the burning gases from the stove, but this is not to be recommended on account of the danger from sparks in the smoke passage, The air within it, thus heated considerably above the mean temperature of the room, will rise, and form an appreciable draught, thus drawing from the floor by displacement. It will be be seen that the effectiveness of this depends on the amount of heat which can be concentrated about the pipe at one point. The other radiating surface must be so disposed as to aid a circulation of air about the room, and produce a swirling current towards the outlet.

ACTS AS COLD AIR INLET

Were the outlet to be made simply a register in the outer wall of the building, instead of serving as a ventilator, it would act as a cold air inlet, the heated air within drawing in more and more by displacement, and as a result there would be no real ventilation. If the natural tendency of the air to be used, and the outlet be at the top of the room, as in many of the older systems in present use, a current of heated air will be set up in an upwardly curving line from the radiator to the outlet; the heat will largely go to waste, and eddies of stagnant air will accumulate along the floor.

This is what must be particularly avoided in motor-houses, as it is the floor line which must be cleared first. By reversing the natural tendency, wholly or in part, and placing the

source of heat upon the walls, or at the top of the room, and drawing away the spent air and gas from the bottom, uniform heat distribution is secured and the necessary drainage effected.

Practical Considerations in the Rating of Heating Boilers

So many practical points are raised in a paper on this subject by A. H. Barker, read at a recent meeting of the Institution (British) of Heating and Ventilating Engineers that his arguments will apply with equal force to American as they do to English practice. Following are the main portions of this paper:

The ordinary client who puts in a heating installation in his own house, or in a public building, wants to be kept warm without feeling stuffy, and he cares not at all how it is done, nor what the temperature is, so long as he feels comfortable, and provided he is not worried by complaints from the caretaker. He does not want the installation to be expensive in fuel, although generally he has the vaguest possible idea of what fuel it ought to burn, and does not wish it to take up much of the caretaker's time. His ideal boiler is one which has a good big firebox which can be filled up with fuel, and which can then be left to burn itself out. Further, he does not want to be faced with heavy repair bills—in a word, he wants a boiler that never comes under his notice at all, either by breakdown, noise, smell or coldness of his radiators. His opinion of the boiler is based on what his caretaker tells him about it, what it costs him in fuel and repairs and how much of the caretaker's time it occupies.

The attendant forms his opinion of a boiler almost entirely from the amount of personal trouble it gives him. If it is easy to clinker, clean and stoke, strongly made, and well above its work, with the circulations well arranged so that the radiators heat evenly; and, above all, if he can fill it up with fuel and leave it alone for many hours, he is apt to conclude, and convince his employer, that the boiler is good, even though it should be frightfully extravagant in fuel and repairs.

HEATING ENGINEER'S OPINION NOT ALWAYS SCIENTIFIC

The heating engineer's opinion is often based on grounds almost equally unscientific. He generally favors the cheapest boiler which will work up to its catalogued power without causing him trouble after it is installed. He dislikes a boiler which develops leaks or cracks (it might be from inferior nipples or other causes, or from being badly installed), or a boiler lightly constructed with hinges that rust away, and doors that warp. A boiler which gives rise to any complaint of any sort from the client, whether well or ill founded, involving an expensive journey to inspect it, is one which the heating engineer does not usually install.

In this country (England), fuel consumption is a secondary matter as far as the heating engineer is concerned. He is not generally asked for a guarantee of fuel consumption, and if he were a wise man he would certainly decline to give it, on the ground that it depends on the efficiency of the stoking, or our changeable climate, which makes a satisfactory prolonged test impossible. The total fuel burned in a winter may vary 50% or 100%, according to the mildness or otherwise of the winter. In this country the man who has his house warmed by an apparatus is generally well to do, and the consumption of a few tons of coal is secondary in importance to having the house comfortable.

MAKERS OF BOILERS RELUCTANT TO DISCLOSE METHOD OF RATING

It is easy to understand the maker's attitude. He does not wish to disclose his method of rating for fear his competitors might "go one better."

Makers should not consent, in the absence of some definite understanding on the subject, to rate their boilers at less than the maximum which they think obtainable. The question, therefore, arises how far it is possible or desirable to induce boiler makers to consent to a uniform system of rating on the basis of actual heating surface.

Some boiler makers claim that their particular arrangement of heating surface ensures better transmission and more efficient utilization of the heat generated in the furnace than the arrangement of their competitors, and they will hardly consent to be rated on the same basis as a competitor whose design they consider inferior. If a maker has been to considerable expense in making tests, and secures certain experimental results from his boilers, he will decline to rate them at a lower figure merely because a committee of that institution has decreed that a lower rating is desirable. Again, if a manufacturer has been rating his boilers according to a tradition of his firm, or according to Hood's formula or some other basis, to alter his rating will involve an apparent increase in his catalogue price, which he might properly think bad for his business.

RATING WANTED FOR EACH BOILER

Roughly speaking, what heating engineers will probably wish to get from this committee is something of this kind: they wish them to examine, measure or test, either themselves or by proxy, the existing boilers now on the market, and state whether or not they are fairly rated, and, if not, what, in their opinion, the rating should be for each boiler of each maker, or, perhaps, to obtain an undertaking from the maker that he will give the rating according to a standard, presumably to be agreed on in accordance with the results of certain experiments to be initiated or recommended by that committee.

The broad result will then be that the heating engineer will be certain that if his job is, say 2,000 sq. ft., and he puts in a boiler rated on the standard basis as 2,000 sq. ft., the boiler will actually heat that 2,000 sq. ft. up to the specified temperature. A standard rating is of no use whatever unless it can be relied on absolutely. An engineer who puts in a boiler of the proper calculated size will know, if it does not do its proper duty, that the boiler is not at fault.

DIFFICULTIES OF ACCURATELY RATING BOILERS

The crucial question is, whether it is possible to rate boilers according to a standard which is scientific, practical and accurate. Is it possible by codifying, tabulating and analyzing the results of a large number of careful experiments, to arrive at such a formula as will give what might be called a figure of merit of any boiler, so that one would be enabled to say of two boilers of different types, from measurements alone, that the power of the one is to the power of the other, in the same situation and provided with the same fuel, as say 1 to 1.34? Has 1 sq. ft. of direct heating surface —*i. e.*, in contact with flame—always the same power, however it is disposed with regard to the hot gases passing over it? If it has not, then unless one can calculate as many factors as there are different possible dispositions of heating surface, it is impossible by any conceivable system of calculation from the measurements only to arrive at a close approximation of the power of the boiler, and the actual heating surface, however accurately given, is not an accurate indication of the power of the boiler.

MEASUREMENTS OF HEATING SURFACE NOT A GUIDE

It is quite certain that different portions of the direct fire surface of the same boiler do in fact possess widely different values as heating surface, and it appears to be proved that it is quite possible to have two boilers of different types, each having, say, 30 sq. ft. of direct fire surface, and 60 sq. ft. of indirect, and say 70 sq. ft. of secondary surface, whose heating powers may be widely different. That being so, mere measurements of the surface, however carefully made, are no reliable indication of the power of

a boiler, and one maker's tests will be of little use to any other maker of a different type of boiler.

The author's own opinion is that the only method of ascertaining accurately the power of any boiler is to make a prolonged and careful test on a boiler of similar design. It is practicable so to test boilers as to obtain a result which can be reproduced at any future time, and no test is of any value unless it is made in such a way that the same result can be reproduced at any future time if required. He believes, too, that if tests are made of several boilers of a series, all being of similar design, a formula can be evolved which would give a close approximation to the actual power of any boiler of that design if tested in the same way as the other. That, in his view, represents the limit of possibility in evolving formulæ for boiler rating, and, if anything more is attempted, if an attempt is made to rate boilers of different design from the same formulæ, it will, he fears, be a failure.

Data on Central Heating Stations

In a study of the problem of burning coal without smoke, which for some time past has engaged the attention of the Technologic Branch of the United States Geological Survey, the investigation was extended to include the operation of central heating stations.

The result was a gathering of data regarding central station heating such as has never heretofore been collected, and some of the data form a valuable contribution to the fund of information on this subject. It is contained in Bulletin 373, published by the Geological Survey, under the authorship of D. T. Randall and H. W. Weeks.

"The central heating plant," says the report, "is not a new thing; in fact, plants have been in operation for 20 to 25 years. Development in this direction has been very slow, however, until within the last five or six years, when the idea has received renewed attention."

The data presented in the accompanying tables were obtained by sending a circular letter to each of the central heating plants supposed to be in operation in the United States—150 in all. Of these, 77 responded, 57 giving the information as tabulated; 20 stated that they were out of business or inactive. The location of the 130 is given in the statement below. The tabulated statistics may be taken as fairly representative of central heating plant conditions. It will be noted that the plants are most numerous in the States where coal is relatively cheap.

LOCATION AND NUMBER OF CENTRAL HEATING PLANTS

	Number of Plants
Arkansas	1
Colorado	2
Connecticut	1
Georgia	1
Idaho	1
Illinois	24
Indiana	17
Kansas	1
Massachusetts	2
Michigan	3
Minnesota	3
Montana	1
Missouri	4
New Hampshire	1
New York	10
North Dakota	2
Ohio	24
Pennsylvania	25
Rhode Island	1
Texas	1
Washington	1
Wisconsin	4

Of the 57 plants included in the tables, only 12 were operating for the express purpose of central heating. The remaining 45 were supplying either light and heat, power and

TABLE I. DETAILS OF OPERATION OF CENTRAL HEATING PLANTS

No.	Location of plant.	Space in buildings (cubic feet).	Average price of heating. Per square foot.	Average price of heating. Per 1,000 pounds of water.	Average cost per year for repairs on mains, tunnels, and insulation.	Years in operation.	Remarks.
1	Colorado	700,000	$0.65		$1,500	26	Condensation loss, 12 per cent. Price to large dealers, $2 per 1,000 cubic feet of contents.
2	Illinois	1,200,000	.24			12	$4 per 1,000 cubic feet of contents
3	do			$0.45	None.	3	Live steam one-tenth of season.
4	do				Very small.		Radiation direct and indirect.
5	do					7	Direct system.
6	do		.25		$100	5	Profitable when heat is furnished as a secondary product.
7	do		.25		None.	2	
8	do	a 9,000,000 b 9,450,000	a .25 b .15			a 17 b 5	Do.
9	do		a .22½ b .75½			6½	Would advise concentration of mains
10	do		.15		10 per cent.	6	Would advise use of larger mains; also concentration of territory heated. Insulation could be improved.
11	do		.20			7	
12	Indiana		.20			5	
13	do		.18		$400	5	Profitable when heat is furnished as a secondary product
14	do		.15½			5	Charge too low for successful operation.
15	do		.12½			7	Do.
16	do		.15			5	Condensation loss, 5 per cent
17	do		.17		5 per cent.	10	Radiation mostly direct. Heat should be automatically regulated.
18	Iowa		.18		$300	7	Mains should not extend too far from plant
19	do		.20		$100	6	
20	do		.15			5	Profitable when exhaust steam is used for heating.
21	do	10,000,000		.50	$350	15	Radiation mostly direct.
22	Michigan	2,389,990			$150	3	
23	Minnesota			.60	$6	8	Radiation direct and indirect. Condensation loss, 6 per cent.
24	Missouri	3,771,515				5	
25	do	3,634,365			$25	4	
26	do	5,391,295		.56	0	7	Radiation direct and indirect. Condensation loss 1 per cent.
27	do	1,650,000			0	15	
28	do	2,204,612	.25		0	10	Mains should not extend too far from plant.
29	Montana	7,777,000	.60		Very small.	7	88,000,000 pounds steam sold per year.
30	New York			.50		25	Over one-half of the steam is sold for power purposes.
31	do	100,000,000		.50			
32	do	15,500,000			Small.	10	Profitable when exhaust steam is used.
33	do	10,000,000		42½	$175	28	Condensation loss, 3 to 6 per cent. Radiation both direct and indirect
34	New York	7,000,000			3 per cent.	10	Condensation loss, 5 to 12 per cent. Radiation both direct and indirect. Business rate $7, residence rate $4.50 per 1,000 cubic feet of contents.
35	do			$0.48	Very small.	6	
36	North Dakota	5,000,000		.40	0	7	Condensation loss, 5 per cent on heavy load, to 50 per cent on light load.
37	do			.40		6	Profitable when exhaust steam is used.
38	Ohio		$0.15		0	3	
39	do		.15		Very small.	5	Natural gas 9 cents per 1,000 cubic feet.
40	do		.20		$300	7	
41	do	1,200,000	.17½		0	4	
42	do	10,000,000		.50	0	7	
43	Pennsylvania	26,000,000			$2,000	10	$4.50 per 1,000 cubic feet of contents; should have larger mains.
44	do	10,000,000			($0.41 per 1,000 cubic feet of space heated.	19	$4.43 per 1,000 cubic feet of contents; steam should be metered.
45	do	9,129,251			$300	14	Radiation should be direct and steam should be metered. Present price of heating based on cubic contents.
46	do	3,360,000	.25		$250	5	
47	do	9,000,000			$702	9	Radiation both direct and indirect. Profitable when exhaust steam is used for heating.
48	do				$500	20	$5.45 per 1,000 cubic feet of contents.
49	do					20	$4.50 per 1,000 cubic feet of contents. Insulation could be improved. Should run with higher steam pressure at plant.
50	do			.40	0	5	Condensation loss, 9 per cent. Profitable when steam is sold at 60 cents per 1,000 pounds.
51	do	5,000,000			$700	19	Radiation about 5 per cent. $5 per 1,000 cubic feet of contents.
52	do	5,093,161			$500	14	$6 per 1,000 cubic feet of contents. Radiation should be direct and service should be metered.
53	do		.34		$100	10	
54	do		.33½			24	Very little indirect radiation. Mains should not extend too far from plant.
55	Rhode Island			.66		6	Condensation loss, 4 to 15 per cent.
56	Wisconsin		.25			6	Profitable when exhaust steam is used.
57	do		.20			8	Insulation could be improved. Mains should not extend too far from plant. Profitable when exhaust steam is used.

a Steam. b Hot water.

heat, or power, light, and heat. Steam heat is furnished by 38 plants, hot water by 17, and a combination of steam and hot water by 2. The plants which have been installed in the last five or six years, show about an equal proportion of steam and hot-water heating.

The plants range in size from 300 to 16,000 H.P.; only 25% are of 600 H.P. or less. Sixteen of the plants have mechanical stokers.

The price of coal ranges from $4.60 per short ton in Montana to 90c. in Illinois, the average cost from all the plants being $2.05 per short ton. Both direct and indirect radiation are used, but by far the greater proportion is direct. The greatest distance to which heat is sent from the station varies considerably, but a reasonable distance seems to be about 4,000 to 5,000 ft.

RATES FOR HEAT

Payment for the use of steam is made in two ways—(1) at a flat rate, based on square feet of radiating surface installed or on 1,000 cu. ft. of contents heated, or (2) at a meter rate, based on 1,000 lbs. of condensed steam. The price paid per square foot of radiating surface averaged 33⅓c., and varied from 22½ to 65c. The plants selling on a basis of 1,000 cu. ft. of contents charged an average of $4.46, the price varying from $2 to $6. On the basis of 1,000 lbs. of condensed steam the payments averaged 50½c., ranging from 40 to 66c. One plant that sold heat on this basis for 40c. intimated that such a rate was not profitable.

The hot-water plants sold heat

only on the basis of square feet of radiating surface installed, the average rate being 17½c. and the range from 12½ to 25c. per square foot. Two plants, one selling at 12½ and the other at 15½c., claimed that their prices were too low for successful operation.

A comparison of the prices charged by central stations, as given in the table, with the cost of fuel only for a house-heating boiler, as published in Bulletin 366, shows that in many cases the cost of producing heat on the premises equals the price charged by the central station. When heat is purchased the customer avoids the annoyance of having to supervise the operation of the heating plant, as well as the dust resulting from the delivery of fuel and the removal of ashes. Some allowance should also be made for the space that would be occupied by the heater and for the expense necessary to install and keep a boiler in repair.

SUGGESTIONS FOR OPERATION OF PLANTS

The following suggestions have been made by the managers of the plants and are worthy of consideration:

Heat from a central plant should be, as largely as possible, a secondary product.

Heating mains should be concentrated and should not extend too far from the station.

TABLE II. DETAILS OF OPERATION OF CENTRAL HEATING PLANTS

No.	Location of plant.	Live steam used (per cent).	Mains leading from plants.		Pressure (pounds).		Greatest distance heat is conveyed (feet).	Total length of heating mains (feet).	Insulation.	Radiation (square feet).	
			Number.	Size (inches).	On mains at plant.	Drop in main.				Direct.	Indirect.
1	Colorado	100			50	42	7,550	38,173	Lapped with asbestos inside 4-inch wood log		Very little.
2	Illinois		1	8	15	12	3,960	10,560	Tin, asbestos, and 4-inch wood log	200,000	None.
			1	12							
3	do		1	20	20	15	7,200	14,784	4-inch wood log		Very little.
4	do	33	1	10	10	6	2,000	4,000	1-inch magnesia pipe covering		
			1	6							None.
5	do	0	1	5	3-6	2	3,960	7,920	1-inch felt and wooden box	35,000	
6	do		1	8	6-15	1-3	2,640	2,640	6-inch wood logs	2,000	None.
7	do	0	1	8	2	½	1,300	4,000	7-inch hemlock and hair		
8	do	50	a 1	10	a 8-8 50		5,280	a 15,840 b 31,680	Air chambers and sawdust	a 180,000 b 270,000	
			b 1	12							
9	do		a 1	12	6	6	a 3,000 b 6,600		Magnesia and oil shavings	75,000 x 2	Very little.
			b 1	8							
10	do	65	1	7	60	10	7,920	58,080	3-inch wood box	100,000	None.
11	do	0	1	10	88	9	2,640	17,500	2-inch sawdust and lime		Do.
12	Indiana	0	1	20	30				Boxing; mineral wool	400,000	Do.
13	do		3	12	48	20	3,960	10,560	3-inch wood covering	120,000	Do.
14	do		2	10	70	40	4,500	34,000	4-inch wood and hair felt	130,000	Do.
15	do		1	7	40	10	5,280	15,840	4-inch wood logs	60,000	Very little
			1	6							
16	do	16	c 1	12	50	25	1,500	12,000	5-inch hemlock boards and air space	70,000	None.
17	do	15	c 1	6	60	15	5,000	18,480	5-inch air space; boards and shavings, and tarred felt	115,000	
			c 1	7							
18	Iowa	33½	1	8	45-60	10-15	3,520		Hemlock covering, with two air spaces	85,000	None.
19	do	75	c 1	7	54	8	3,000	d 8,800	1½-inch wood	61,000	Do.
20	do	(e)	1	5	30		2,000	4,000	Wood	20,000	Do.
21	do		1	12	17	15	4,500	12,000	4-inch wood logs	138,000	
22	Michigan	66	2	10	3	½	1,300	4,000	2-inch 85 per cent magnesia	50,000	None.
23	Minnesota	(f)	1	8	5	0	1,600	3,960	3-inch wood logs	30,000	
24	Missouri		1	16	3		3,072	1,400	1-inch paper; air cell	11,481	150,460
25	do	(g)	2	12	½	0	400	700	1-inch 85 per cent magnesia	4,900	None.
26	do	100	1	10	5	1	4,640	7,920	4-inch kiln-dried pine; wood log	83,082	
27	do		7	6	11	0	130	600	½-inch magnesia	33,000	None.
28	do	50	1	10	55	1		700	1-inch asbestos	38,267	Do.
29	Montana		8	12	10	½	2,000	4,000	1-inch asbestos; sponge felt	70,000	Do.
30	New York	100	1	12	95	10	3,200	29,040	1-inch air space; 4-inch mineral wool inside conduit		
31	New York	100	1	15	55	5-15	7,500	58,080	1-inch air space; 4-inch mineral wool inside conduit	1,100,000	
			1	24							
32	do		1	15	5		922	4,070	1½-inch 85 per cent magnesia	65,430	None.
			1	12							
33	do	70	4	14	4½	3½	3,960	31,680	4-inch kiln-dried sectional white pine, wood logs	124,000	
34	do	100	1	10	20	5	5,280	7,000	Tin, asbestos, 4-inch wood logs		Very little.
35	do	100±	1	8	5	0	1,300		4-inch wood log		
36	North Dakota	50	1	10	7½		1,500	3,000	Tin, asbestos, 4-inch wood logs	50,000	None.
37	do		1	12			1,000	2,000	Tin, asbestos, and wood logs		
			1	8							
38	Ohio	0	2	12	45	30	11,880	47,520	5-inch wooden box; air space; oil shavings	160,000	None.
39	do	0	2	8	70		6,600	21,120	Wood shavings and mineral wool	110,000	Do.
40	do	20	2	8	30	6	5,500	10,560	5-inch wood; air space; box	80,000	Do.
41	do	(h)	h 2		40	15	3,520	7,000	2-inch wood covering	30,000	Do.
42	do	100	1	14	¼-6		3,178	5,492	4-inch tin-lined wood casing		
43	Pennsylvania	(i)	12	3	50	47	5,280	66,200	Tin-lined 4-inch wood log		
44	do	100	10	3	5-20		5,280	11,880	3-inch wood log	42,000	
45	do	100	1	10	12-25	7	3,917	28,945	Asbestos and 4-inch wood logs	29,785	162,182
			2	6							
46	do		1	14	2-6		4,000	13,200	Tin, asbestos, 4-inch wood logs	50,400	5,600
47	do	100	1	12	15	11		9,500	4-inch asbestos and wood logs		
48	do	100	1	8	20		3,960	3,960	½-inch asbestos		
49	do	100	1	10	30	25	6,000	6,000	2-inch asbestos and wood log		Very little.
50	do	50	1	12	4	2½	3,550	8,777	Tin, asbestos, 4-inch wood logs	88,611	None.
51	do	100	1	10	50-70	35-40	5,000	7,200	4-inch wood log	70,000	
52	do	100	1	8	10-20	5-15	4,620	17,911	3-inch concrete duct; 3-inch and 4-inch wood log; 3-inch air space.	57,324	60,909
			1	12							
53	do		1	8	6	(a)	3,960	7,920	1-inch wood		None.
54	do	100	1	8	15-40	10-35	2,640	10,560	Asbestos and 4-inch wood logs	45,000	
55	Rhode Island	100	1	8	14	5	2,042	5,285	Tin, asbestos, 4-inch wood logs		Very little.
56	Wisconsin	90	1	4	55	15	2,000	4,000	1½-inch wood log	10,000	None.
57	do	0	2	8	60	40	7,920	31,680	3-inch hemlock boxing and air space	70,658	Do.

a Steam. b Hot water. c Pair. d Double pipe. e Very little. f 75,000 pounds per day. g 146,000 pounds per day.
h Very little. i Pair. j Nearly 100.

TABLE III—DETAILS OF OPERATION OF CENTRAL HEATING PLANTS

No.	Location of plant.	Purpose of plant.	Heating system.	Boilers.		Style of furnace.	Fuel.		Horsepower of engine.
				Character.	Horsepower.		Kind.	Cost per short ton.	
1	Colorado	Heat	Steam	Fire tube	1,500	Common	Lignite slack	$1.33	
2	Illinois	Light, heat, and power	do	Water tube	2,200				
3	do	do	do	do	4,200	Dutch oven	Bituminous slack	1.00	4,000
4	do	do	do	do	2,520	3 Green; 2 common	Bituminous screenings	1.50	3,150
5	do	do	do	do	1,800	Chain grates; Roney stokers	Bituminous pea and screenings	1.38	500
6	do	do	do	Fire tube	1,350	Common and chain grates	Bituminous screenings	1.85	1,700
7	do	Light and heat	do	do	600	Common	Run of mine and lump	1.50	400
8	do	Light, heat, and power	Steam and hot water.	do	450	do	Bituminous run of mine	1.70	120
9	do	do	do	Water tube	2,970	Chain grates	Bituminous screenings	.90	4,100
10	do	do	do	do	2,800	do	Run of mine and screenings		3,200
11	do	do	Hot water	do	1,100	Common	Bituminous screenings	1.20	1,250
12	Indiana	do	do	do	400	do	Bituminous 1-inch screenings	1.47	375
13	do	Light and heat	do	do	1,800	Detroit and Roney stokers	Bituminous screenings	2.50	
14	do	Light, heat, and power	do	do	1,720	Common	Bituminous slack	1.35	2,500
15	do	do	do	do	1,000	do	Run of mine; screenings	1.75	570
16	do	do	do	Fire tube	400	do	Bituminous run of mine	1.12	
17	do	Light and heat	do	Water tube	800	1 common; 2 Roney stokers	Bituminous	2.61	515
18	do	Light, heat, and power	do	Fire and water tube	800	Common	Bituminous slack	2.20	880
19	Iowa	Light and heat	do	Water tube	800		Nut and run of mine	1.70	425
20	do	do	do	Fire tube	400	Common	Run of mine, nut steaming	3.00; 2.12	150
21	do	Light, heat, and power	do	do	320		Bituminous lump	1.95	350
22	Michigan	Light and heat	Steam	Water tube	2,150	2 chain grates; 7 common	Bituminous screenings	1.70	2,800
23	Minnesota	Light, heat, and power	do	Fire tube	600	Morrison suspension	Bituminous slack	2.99	400
24	Missouri	do	do	Water tube	725	Common	¾ anthracite, ¼ bituminous	3.75	700
25	do	do	do	Fire tube	900	Down draft	Bituminous lump	1.67	405
26	do	do	do	Water tube	900	2 down draft; 1 common	do	2.05	1,264
27	do	Heat	do	do	750	Common	Bituminous slack	1.75	0
28	do	Light, heat, and power	do	Fire tube	450	Down draft	Bituminous pea and nut	1.80	280
29	do	do	do	Fire and water tube	400	do	Bituminous lump	2.10	200
30	Montana	Light and heat	do	Water tube	1,500	American stoker	Bituminous slack	4.60	250
31	New York	Power and heat	do	do	16,000	Common	Anthracite	2.23	0
32	do	Heat	do	do	11,000	do	do	2.23	0
33	do	Light, heat, and power	do	do	2,508	do	Buckwheat	2.13	1,475
34	do	Light and heat	do	do	1,600	Murphy stoker	Bituminous	2.50	705
35	do	Heat	do	Fire tube	700		¾ anthracite, ¼ bituminous	1.74; 2.90	0
36	do	Power and heat	do	do	405	Murphy stoker	Screened nut	2.60	430
37	North Dakota	Light, heat, and power	do	Water tube	1,000	Common	¾ anthracite, ¼ bituminous	4.00	1,500
38	do	do	do	Fire tube	600		Lignite	2.00	600
39	Ohio	Light, heat, and power	Hot water	Water tube	2,800	Dutch oven	Run of mine	$2.20	3,000
40	do	do	do	do	1,400		Run of mine, slack, natural gas	1.30	550
41	do	do	do	Water and fire tube	1,100	Common	Pea and slack	1.50	750
42	do	Heat	Steam	Water tube	950	do	Bituminous run of mine	2.25	1,000
43	Pennsylvania	do	do	Fire and water tube	1,200	6 common; 2 Murphy	Run of mine and slack	1.75	0
44	do	do	do	Fire tube	1,600		Anthracite buckwheat	1.50	0
45	do	Power and heat	do	do	1,700	Common	Anthracite and bituminous	2.25	0
46	do	Light, heat, and power	do	Fire and water tube	1,550	8 underfeed; 1 common	Bituminous	2.75	
47	do	do	do	Fire tube	1,600	Roney stokers	Slack	1.00	1,200
48	do	Heat	do	Fire and water tube	1,400	Common	Bituminous	2.59	1,050
49	do	do	do	Fire tube	1,200		do	1.03	0
50	do	Light, heat, and power	do	do	1,000	Common	Anthracite rice and buckwheat	1.14	0
				Water tube	950	Murphy stokers	Anthracite rice and bituminous run of mine.	2.63	1,050
51	do	Heat	do	Fire tube	900	Common	Anthracite	1.03	0
52	do	do	do	3 fire tubes; 1 water tube.	725	Wilkinson stokers	Bituminous	2.77	0
53	do	Light, heat, and power	do	Water tube	600	Common	Run of mine	1.38	300
54	do	Heat	do	Fire tubes	600	do	Bituminous run of mine	1.37	0
55	Rhode Island	Light, heat, and power	do	Water tube	3,315	do	Bituminous	3.75	4,250
56	Wisconsin	do	Hot water	Fire and water tube	600	do	Bituminous screenings	1.90	800
57	do	Light and heat	do	Water tube	600	do	Bituminous run of mine	2.50	800

Direct radiation should be installed.

Mains should be of sufficient size to avoid the necessity of high pressure at the station.

Heat should be under automatic control.

The flat rate is not a successful basis for payment: the service should be metered.

Figuring Resistance in Air Filters

Air filtering material offers a certain resistance to the air current passing through it. This resistance preeminently depends upon the volume of air passing the filter, the kind and condition of the filtering material and the size of the filter area. It increases with the air volume as well as with the density and thickness of the filter layer and the length of time the filter has been in use. It may be mentioned that there are other determining influences, such as temperature, pressure, humidity and the location of the filtering surface relative to the direction of the air current.

The main factors, such as resistance, air volume, permeability, and filter area bear a relation to each other according to a fixed law that may be expressed from experiments made by one of the large German manufacturers of air filters, K. & Th. Moeller, of Brackwede, Westphalia, by the following formula:

$$H = \gamma_1 \times \frac{L_0}{F} + \gamma_2 \left(\frac{L}{F}\right)^2$$

$$L_0 = \frac{L \times b}{(1 + \alpha t) 760}$$

in which H = resistance of the cloth, expressed as the difference of the pressure in front and behind the filter measured in millimeters water column. t = temperature in degrees Centigrade. b = air pressure in millimeters mercury column. L = volume of air of temperature t and pressure

h to be filtered per hour, in cubic meters. L_0 = air volume reduced to O° and 760 millimeters barometric pressure. a = coefficient of expansion for air (1 ÷273). F = effective total filter area in square meters. y_1 = empirical constant depending mainly upon the thickness and state of the filter material. y_2 another empirical constant depending on the size of the

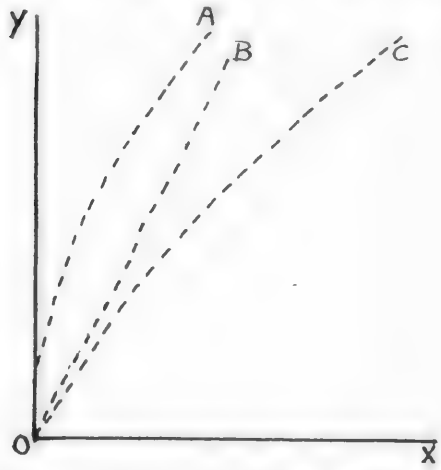

FIG. 1. CURVES ILLUSTRATING AIR FILTER FORMULA

pores in the filtering material and their number per unit of area.

Fig. 1 shows graphically the above equation for various filter materials; that is, for various values of y_1 and y_2. The resistances are laid off as abscissae and the air volumes as ordinates.

Applying the equation to the curves we have the following:

For y_1 = O the first term on the right side vanishes and the curve becomes a parabola with its apex in the origin O, and tangent to the axis of ordinates (Curve A) which means that if the air had no work to do in overcoming resistance while passing the filter material, the air volume would be proportional to the square root of the resistance, so that only that resistance came into play which is caused by the decrease of the cross sectional area.

For y_2 = O the second term of the right side vanishes and the equation is that of a straight line passing through the origin (Curve B). This means that if the air suffered no throttling, due to decrease of pressure and it had to overcome frictional resistance only, then the resistance would be directly proportional to the air volume.

Since, however, in filtering, both kinds of resistances are present, the curve presents itself as a parabola whose tangent in the origin is at an angle with the axis of the ordinates (Curve C).

It thus follows that the resistance to an air current caused by the filter is composed of the sum of the resistance due to friction within the filter material plus that due to the decrease of the cross sectional area.

Calculations for Forced Hot Water Heating

By Fred B. Craig

An interesting method of figuring a design for a forced hot water heating system is contained in a paper on "The Heating and Ventilation of a General Hospital," by F. B. Craig, read before the Institution (British) of Heating and Ventilation Engineers, in London, October 5th last.

After describing the proposed layout for a hospital building, the author proceeds to give the following methods which he has used and found successful:

HEAT LOSSES IN THE ROOMS

Proceed to cube up the various rooms and measure off the amounts of exposed wall and window surface. Decide upon the standard of purity that is to be allowed in the rooms, and then ascertain the number of cubic feet to be supplied per person to maintain this, from any standard authority.

Determine the number of occupants in each room, and calculate the total cubic feet of air to be supplied. Divide this figure by the cubic contents of the

rooms, and so find the air changes per hour.

In those rooms where the number of occupants is unknown I usually calculate on three changes per hour. Lavatories at six changes per hour, and corridors at two changes per hour. Determine temperature required in each room, and decide coefficient of heating surface to produce this temperature.

Calculate the square feet of prime heating surface required, and the percentage of efficiency of radiators, ventilating radiators and pipes.

Enter up these figures in schedule fashion, as follows: Name, Location, System, Temperature of Outside, and Re' .arks:

SUMMARY

		Transmission Totals B. T. U. per B. T. U. square foot per hour
Total square feet direct pipe surface =	1,471 × 167 =	245,657
Total square feet direct radiating surface =	1,227 × 167 =	204,909
Total square feet ventilating radiating surface =	2,376 × 209 =	496,584
Total square feet main pipes, partly covered, measured from plans =	625 × 100 =	62,500
Totals	5,699	1,009,650

SIZES OF MAIN PIPES

A practical and reliable method of ascertaining the sizes of main pipes in an installation of this class is as follows:

First calculate the amount of water to be supplied to the radiating surface per square foot per hour to maintain the requisite temperature in same.

Average temperature of water in radiators =	160° F.
Average temperature of air in room =	60° F.
Difference =	100° F.
B. T. U. emitted per square foot per hour per degree difference in temperature =	1.67
B. T. U. emitted per square foot per hour =	167
Assume	
Average temperature of flow to radiator =	170° F.
Average temperature of return from radiator =	150° F.
Degrees water is cooled =	20° F.

Since 1 lb. water cooled 1° emits 1 B. T. U. per hour, we have: 167 ÷ 20 = 8.35 lbs., or .835 gallons water required per square foot per hour.

Similarly, from ventilating radiators there will be 100 × 2.09 = 209 B. T. U. emitted per square foot per hour; and as the amount of cooling between flow and return is to be also 20° F., we get, 209 ÷ 20 = 10.45 lbs. = 1.045 gallons water required per square foot per hour.

Having determined the number of gallons required per square foot of radiating surface per hour, we proceed to calculate the sizes of main pipes to supply same.

It is safe practice to reckon on a loss due to friction in the pipes of 2 ft. head in every 100 lin. ft. From this we ascertain the number of gallons passed per hour by the various sizes of pipes, with this 2 ft. head per 100 lin. ft.

To accomplish this we adopt the formula by Professor Unwin, viz.:

$$Q = 4.7233\sqrt{\frac{hd^5}{l}},$$

where Q = quantity discharged in cubic feet per minute, h = head in feet, d = diameter in inches, l = length of pipe in feet.

It will be noticed from the formula that the quantity discharged varies as the square root of the head; also as the square root of the fifth power of the diameter in inches; and as the square root of the head, multiplied by the fifth power of the diameter in inches, divided by the length in feet.

By this method we can figure the sizes of mains for varying conditions, though it should be remembered that increasing the head involves an increase in the power required to drive the pump.

BOILER POWER TO BE INSTALLED

From the summary we obtain the total heat emission from the apparatus, and this amount will, providing the calculations have been correctly made, be synonymous with the total heat tansmission from the building.

It is advisable with this class of installation to include for at least two boilers, arranged to work in conjunction. For the purpose of economy in initial outlay each of them need only be large enough to heat one-half the apparatus, as in comparatively mild weather one will be found to be suf-

ficient to supply the entire installation, and in the event of one being temporarily disabled the other will continue to be in operation, and so prevent a total cessation of warmth in the building.

The total heat emission in this case equals 1,009,650 B. T. U. per hour. This amount, divided by 2, equals 504,825 B. T. U. required from each boiler.

Assuming that cast-iron sectional boilers are to be installed, we reckon on a transmission of 8,000 B. T. U. per lb. of coke consumed.

So that 504,825 ÷ 8,000 = 63.10 lbs. coke to be burnt per hour.

Allowing for say 8 hour firing periods, we shall require 63.10 × 8 = 504.8, plus 15% for re-firing = 580.5 lbs. coke space in boiler.

As one cubic foot of coke in boiler weighs about 28 lbs., we require 580.5 ÷ 28 = 20.7 cu. ft. of fuel capacity in each boiler.

ESTIMATED FUEL CONSUMPTION

This is a question which is very frequently asked by intending clients. Owing to the varying conditions met with in actual practice, it is exceedingly difficult to figure at all reliably, and I find it is better to merely state the approximate amounts for hourly periods, and leave it to them to calculate the season's consumption for themselves.

The total B. T. U. emitted from the installation under the stipulated conditions, with the temperature as indicated in the schedule, is equal to 1,009,650. The actual B. T. U. transmitted per pound of coke burnt, being taken at 8,000, we have for these conditions: 1,009,650 ÷ 8,000 = 126 lbs. coke per hour.

This amount will produce a difference between internal and external air of (60° — 30°) = 30°, so that 126 ÷ 30 = 4.2 lbs. (approximately) for each degree of rise. From this we obtain the following figures, though it must be remembered that no allowance is made for the reduction in the efficiency of the boilers when "banked," nor for the increased proportion of heat required for the higher temperature of the outer air:

External Temp. Deg. F.	Internal Deg. F.	Rise Deg. F.	Approx. lbs. coke per hour
30	60	30 × 4.2 =	126
32	60	28 × 4.2 =	118
35	60	25 × 4.2 =	105
40	60	20 × 4.2 =	84

It will thus be seen that the approximate fuel consumption varies as the ratio of temperature rises.

A Few Thoughts About Fans*

By Oswald Stott

Fans are machines for moving air from one place to another. This appears to be quite an unnecessary statement—much too obvious for remark—but as a matter of fact, the duty is often overshadowed by thoughts of the machine and, more particularly, the type of machine.

Within my own experience, fans seem to be, by many people, credited with occult powers, possessed of weird ideas as to what is their true function. There is, as makers of fans are aware, good reason for this feeling; but most sellers—not all unfortunately—know that it is not the fan itself but its application to which the blame should be ascribed. To anyone not versed in the subject it does appear peculiar that a 24-in. propeller fan, say, ventilates one room perfectly, yet fails abjectly with an exactly similar room. That the former fan discharges directly into the atmosphere and the latter into a chimney or a 6-in. drain pipe (actual occurrence) is not considered as having any bearing upon the subject.

Propeller fans cost less than centrifugal fans, and so the tendency is to use them where at all possible.

Air is a fluid, and has considerable weight. Further, when transferred from one place to another through ducts, friction is created, and this

*From a paper read before the Institution (British) of Heating and Ventilating Engineers, in London, October 5, 1909.

friction, or resistance as it is usually called, is the root of all the trouble. If there were no resistance or back pressure, as it may be termed, we should not need to use centrifugal fans at all, because there would be no difference between passing air to the open direct and through a long duct. The crux of the whole matter lies in the resistance, that is to say, the amount of resistance.

To move air from one place to another there must be created a difference of pressure, and, if through a duct, the degree of pressure at one end of the duct determines the quantity of air passed. Conversely, upon the quantity of air to be passed depends the degree of pressure required at the end of the duct; and it is the function of a fan to produce this pressure. The total pressure required is that pressure necessary to overcome the resistance or back pressure plus that which will give the desired velocity to the air.

Supposing that a total pressure of 1-in. water gauge is required it will be evident that a fan which will only set up ½-in. water gauge would not do the work.

The following data relating to both the propeller and centrifugal fans is of the utmost importance:

1. The power varies as the cube of the speed

2. The capacity or output varies as the speed, the conditions remaining the same. So that if you double the speed of a fan you double the output, and require eight times the power. It will be seen that the question of power requires very careful consideration when choosing a fan, and you will find it carefully stated in text books and catalogues that it is not the right thing to speed up a fan to obtain a larger output; but that a larger fan should be used. This statement is correct only if working in the open, or if the ducts are already there and are greater than the area of the fan. Otherwise the same fan may just as well be used if it be efficient in the first case.

To many of us the greatest difficulty is experienced when we wish to decide as to whether a propeller fan or a cased fan ought to be used. To compare, from an efficiency point of view, one with the other, the areas of the diameters of the runner of a propeller fan and the area of the inlet or outlet (the smaller) of the centrifugal fan should be about equal.

Then for equal outputs, except perhaps at free discharge, the centrifugal fan will be the more efficient. Supposing the output to remain the same then, as the resistance increases, the divergence in efficiencies will increase in favor of the cased fan. If it were not that the cased fan costs four or five times as much as the propeller fan, it follows that we would always use it so as to save power. The question to be decided is therefore a balance between economy in first cost and economy in power.

There is one great difference between the two types in that for a given speed, the power with a propeller fan tends to increase slightly as the resistance increases whilst the output quickly diminishes; whereas at constant speed, with a cased fan the power quickly decreases and the output slowly diminishes as the resistance increases.

When the air has to be passed through ducts care is required if the desired quantity through each branch is to be obtained. Sometimes the area of each branch is made proportionate to the amount without regard to the length of it.

FIGURING DUCT SIZES

The correct way to get the size of each duct is to see that the resistances set up in each duct are equal when passing the desired quantity of air. In the plant under consideration it is an easy matter, for they all run into one box right at the fan; but the calculations are very complex in cases where there is a long main duct with branches coming into it at various points.

With propeller fans 1/20 in. w.g. is somewhere about the average resistance. With an electric propeller fan of good design and at standard speed

a resistance of 1/20 in. w.g. will decrease the output by 20% to 25%; with a resistance of ⅛ in. w.g. the output will be reduced from 45% to 50%.

In both cases the fan is to be taken as discharging through the ducts, for at the present moment I am unable to say what the difference is, if any, when exhausting against similar resistances.

If we have purchased a standard electric propeller fan we shall not wish to have a resistance more than 1/20 in. w.g. and our ducts must be proportioned accordingly. Supposing one duct is 10 ft. long, and there are 500 cu. ft. to be passed through it, we find on consulting the table we shall require an 8-in. diameter duct. If another duct is 50 ft. long, and the air per minute is also 500 cu. ft., then we must use an 11-in. diameter duct, although the quantity of air is the same in each.

Taking any plant the conclusion we must arrive at is that the fan must run at such a speed as will set up a pressure capable of overcoming the "greatest" resistance in the system. Seeing the power required increases so rapidly, it means that this "greatest" resistance must not exceed more than absolutely necessary.

EFFECT OF DIFFERENT SIZED FANS WITH EXISTING SET OF DUCTS

It may be interesting to note the effect of choice of size of fan with an existing set of ducts. Supposing a plant exists consisting of twelve 6-in. diameter ducts all 30 ft. long and connected to a box in which the fan would be placed. It is required to discharge a total of 2,350 cu. ft. of air per minute through these ducts, resulting in a velocity of about 1,000 ft. per minute in each. The resistance would be about 1/10 in. w.g. and we will assume that from motives of economy in first cost it was decided to use the propeller type of fan. As the total area of the 12 ducts would be 2.35 sq. ft. we could use either an 18-in. diameter fan or a 24-in. diameter fan if a 21-in. diameter fan cannot be obtained. If we decide to use the 18-in. fan, it would require 45% to 50% more power than in the 24-in. fan, although the area was only 2.35 sq. ft. and the area of a 24-in. fan is 3.1 sq. ft., the area of an 18-in. fan being 1.77 sq. ft. Without first going into the matter, I feel sure most of us would be inclined to put in the 18-in. fan; but evidently it would not be the right thing to do.

Supposing now the quantity of air to be moved was only about 1,650 cu. ft. per minute with the same ducts. The velocity roughly in each would be about 700 ft. per minute, and the resistance 1/20 in. w.g.. If the 8-in. fan were used it would still require about 45% more power than the 24-in. fan, and the 24-in. fan would be the better of the two for the purpose.

IMPORTANCE OF DUCT CONSTRUCTION

Length of duct and the velocity of the air are not the only creators of resistance. The shape of the opening into the duct is of importance. It has been demonstrated by experiment that a hole in a thin plate—*i. e.*, side of a duct—has only about 60% useful area. This is due to a phenomenon known as "*Vena contracta*," and, in effect, means that with a velocity of 1,000 ft. and a 12 in. by 12 in. opening only 600 cu. ft. of air would be passed instead of 1,000 cu. ft. If the actual openings of this type only equal in area that of the fan, a resistance will be set up, because the useful area is but 0.6 the measured and required area. To eliminate this resistance the area of the openings must be either increased until the effective area equals the fan area, or they must be fitted with a bell-mouth in which case the smallest dimensions of the opening must be figured upon. Even with a bell-mouth it is well to add 15% to 20% margin, as it would be too expensive to make the bell-mouths quite the correct shape. It is as necessary to have bell-mouths at the end of a duct as on the sides.

Another point which affects the resistance set up is the radius of the bends where they are required. This radius should be as large as there is space available and the client will pay for.

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A RATHER novel aspect of the smoke problem in industrial centers is presented in a consular report from Germany, where observations have been made of the lessened sunshine due to smoke and fog, both of which are traced to imperfect and incomplete combustion of coal. Statistics have been collected for some time past which demonstrate how little sunshine falls to the lot of the residents in industrial centers. Thus, one German city, Chemnitz, enjoys during the months of December and January 156 hours of sunshine out of the 508 which are theoretically possible, or only 30%. During the entire year the sun shines there only 44% of the number of hours it is above the horizon. In other German cities the figures run from 28% to 42%.

Comparing the situation with that in London, the English capital easily leads in the number of foggy days. It is significant, however, that London's foggy days during December, January and February have increased from 18 to 31 during the last half of the past century.

The investigation in Germany is being made at the instance of societies which are organized to combat tuberculosis, with the distinct view of securing more perfect processes of combustion, the cheapening and increased use of gaseous fuel and a greater utilization of electricity.

A REMARKABLE result of the agitation for better ventilation of railroad coaches is reported by travelers on the Erie Railroad. As a concession to the "fresh-air cranks" among its patrons, the road has recently added to its suburban service a "fresh-air car," so labeled, and carrying a conspicuous notice that "the temperature of this car may be regulated to suit the occupants." The regulation involves the opening of perhaps half of the windows, and the consequent sweep of frosty night air through the car in gusts. It remains to be stated, however, that at this writing the car has been in service for several weeks, and is crowded to the doors each morning and night.

COMMENCING with the December issue of THE HEATING AND VENTILATING MAGAZINE, we shall resume the publication of the full weather data in the cities of New York, Boston, Pittsburg, Chicago and St. Louis, which have become a notable and permanent feature of this journal. The publication of these records is gradually producing a group of statistics of weather conditions much more comprehensive in their way than any published by the government or elsewhere.

MECHANICAL EQUIPMENT

Uniform Torque in Steam Engine Practice

To everyone familiar with the shape and meaning of a steam engine indicator card, it is evident that the thrust given to the piston, by the steam, varies considerably throughout the stroke. Thus, during admission, the pressure is maximum; after cut-off, the pressure gradually falls and finally becomes negative at the end of the stroke, because the steam at the other side of the piston is being compressed. This means that instead of tending to push the crank pin forward the piston really pulls it back.

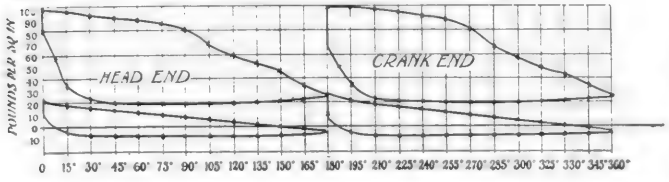
If the engine is a "simple" one, that is, has only one cylinder, it is evident that this varying force on the piston produces a fluctuating turning force at the crank pin and furthermore, on account of angularity of the connecting rod, the force on the crank pin is by no means equal to the thrust on the piston. At the beginning of the stroke the force urging the piston forward is high, as pointed out above, but the force tending to turn the crank, or the tangential force, is extremely low, as the crank is only slightly off "dead center," and most of the thrust given by the piston is expended in pushing directly against the shaft bearing. These changes in tangential effort cause the speed of rotation to vary for different positions of the crank pin. In one-cylinder engines the only way to prevent these variations in speed from becoming excessive is to use a very heavy fly wheel, which will store up energy when the thrust is high and give it up again when the thrust is low. The fact that the turning movement varies with the change of steam pressure in the cylinder, and at the same time with the angle that the connecting rod makes with the line of centers, renders it rather a complicated problem to foresee what the resultant tangential effort will be for any particular engine, without careful computations.

METHODS OF REGULATING TURNING MOVEMENT

One way to produce a more even turning movement is to connect several cylinders to a single crank shaft. This gives numerous impulses per revolution and each being of the same intensity and occurring at equal intervals of time produces a practically uniform turning effort, and also has the further advantage that for a given amount of work the thrusts given by the separate cylinders can be smaller than if all were delivered by one. Could we supply an infinite number of properly designed cylinders we could obtain an absolutely uniform torque. Of course, it is impossible to supply an infinite number of cylinders, in fact, in steam engine practice, seldom more than four are used and these are only found in marine engines. While the above points are all well known, it will, however, be a surprise to many to know how uniform a turning movement can be produced in a two-cylinder engine having the cylinders correctly located and the load properly divided between them.

The following discussion relates more specifically to high speed engines of medium size such as are commonly used for driving lighting units in office buildings, apartment houses, hotels, etc. In isolated plants, such as these, one of the important requirements is to get as much power as possible on a square foot of floor space, and at the same

time to have as low steam consumption as possible, for even where exhaust steam is used for heating purposes no one wants to throw away more steam than is necessary during the summer months when the engines exhaust to the atmosphere. The cross compound engine, while giving as good steam economy as any other type, occupies entirely too much floor space and is seldom used.



INDICATOR CARDS FROM WHICH BOTH CRANK EFFORT CURVES SHOWN BELOW WERE CALCULATED

The two types of engine which meet these conditions most satisfactorily are the angle and the tandem compound, but as shown below, the relative positions of the cylinders have a marked bearing on the performance of the engine.

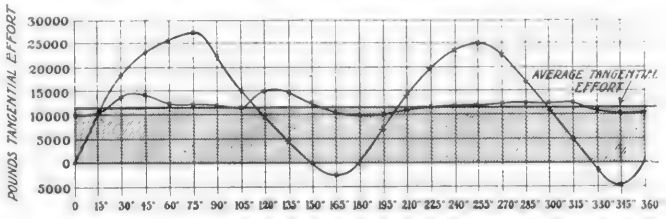
OPERATION OF TANDEM COMPOUND TYPE

In the tandem compound both pistons are on the same piston rod, one behind the other, and always move together. A little thought will show that as both pistons are always moving in the same direction, there will be an enormous thrust delivered at the beginning of the stroke and when both are receiving maximum steam pressure. After the point of cut-off the steam expands in both cylinders, the thrust gradually falls off until it reaches zero and then becomes negative due to high compression necessary with the high speed commonly used in connection with small sized units.

Thus it is seen, with this construction, the pressures on both pistons, whether positive or negative, are always added together, the pistons given a violent kick at the beginning of each stroke, and are, in fact thrown back and forth more like a shuttle; therefore, unless an immense fly wheel is used, anything like a uniform turning movement is impossible.

OPERATION OF ANGLE COMPOUND TYPE

In the angle type engine, such as that illustrated herewith, the low pressure cylinder is placed vertically on the same bedplate with the high pressure and at exactly 90° to it. In this case it will be seen that the maximum thrust, due to the admission of steam to the low pressure cylinder, does not occur until after the high pressure cylinder has finished half its stroke, and the pressure in it is rapidly falling off. The maximum pressure occurs in the low pressure cylinder and after it has finshed half of its stroke, steam is again admitted to the other side of the high pressure piston, and so on. It will thus be seen that instead of the two maximum thrusts occurring at the same time, there are four which follow one another with uniform regularity. This arrangement tends to produce a more uniform turning force, and the following diagrams have been worked out, to show how the force actually varies in the two cases.



CRANK EFFORT DIAGRAMS: A—FOR TANDEM COMPOUND ENGINES; B—FOR ANGLE COMPOUND ENGINE BOTH ENGINES DELIVERING THE SAME AMOUNT OF ENERGY, REPRESENTED BY THE SHADED AREA

DIAGRAMS ILLUSTRATING VARIATION OF FORCE IN TANDEM COMPOUND AND ANGLE COMPOUND ENGINES

The four indicator cards in Fig. 1 are from a compound engine and the same cards were used in figuring out both curves in Fig. 2.

The positions of the cards as

shown in Fig. 1 represent the events as they occur in a tandem engine. Curve A was plotted from the cards in this position. The ordinates for each card were taken for every 15° turned through by the crank and multiplied by the corresponding piston areas. The sum of these two gives actual pounds thrust on the piston. This was then corrected for angularity of piston rod, so that of the total thrust, only that portion was plotted which tends to push the pin in a circular path.

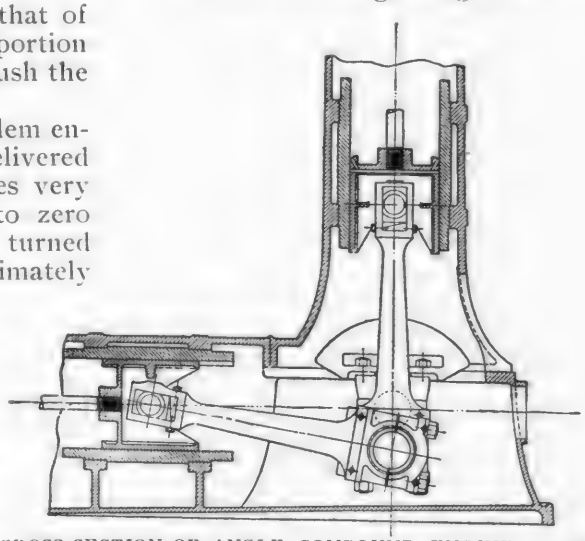
It is seen that with the tandem engine, the tangential force delivered to the crank pin at first rises very rapidly, then quickly falls to zero and when the crank has turned through an angle of approximately 150° or is very nearly at the end of one stroke the force becomes negative. This is due to the fact that the steam pressure resulting from expansion is rapidly becoming lower while the steam on the other side of both pistons is being compressed at the same time, hence, at this point, instead of the pistons tending to drive the pin forward they become a drag and have to be carried to the end of the stroke by the inertia stored up in the fly wheel.

Curve B shows the crank effort from an American Ball angle compound engine. Here the low pressure cards are moved forward 90° and the tangential efforts were figured out separately for each cylinder for every 15° and then added together. The remarkable thing about this curve is its extreme "flatness" which shows how small the variation in turning movement is in this engine.

In these curves the modifying effects of friction, and inertia of reciprocating parts have been neglected, in order not to complicate the problem, but had the effects of inertia been taken into consideration, the results would have shown up still more favorably to the angle compound type, as the masses moving in the same direction are smaller and the fact that they are separated 90° allows of perfect balancing, which is impossible with either the tandem or cross compound construction.

AMOUNT OF ENERGY THE SAME FOR BOTH ENGINES

The line of average tangential effort was located in the force diagram by means of a planimeter and was found to be the same for both engines, showing that the total amount of energy delivered by both is the same. This line is at the top of the shaded area and represents the *continuous* pressure necessary to carry a given load; when this necessary crank pin pressure is exceeded in one part of a revolution there must be a corresponding deficiency in another part. From curve A, it is seen that the turning pressure on the crank pin of a tandem engine rises very greatly above the average amount twice in every revolution and falls not only to zero, but becomes negative due to the compression at the end of the stroke. The only practical way to try and smooth out the turning movement delivered by one of these engines is to use a heavy fly wheel which takes the ex-



CROSS SECTION OF ANGLE COMPOUND ENGINE SHOWING RELATIVE POSITIONS OF CYLINDERS AND OF COUNTERBALANCE WEIGHT

cess energy represented by the area of one peak of the curve above the line of average pressure and carries it over to fill in the deficiency represented by the "valley" in the next portion of the curve.

THE CAUSE OF KNOCKING IN STEAM ENGINES

Another interesting point in this connection is the heavy reversal of stress which occurs near the end of the stroke in the tandem type when both pistons yank back at once. This, of course, tends to loosen bearings, both on the crank pin and on the shaft, and in time, develops "knocking." The much higher values of maximum pressure also necessitates heavier crank pins and engine frames, as the parts of an engine always have to be designed for the greatest forces that they will have to withstand. Then again, when there are only two impulses per revolution they must necessarily be at least twice as strong as when there are four.

IMPORTANCE OF UNIFORM TURNING MOVEMENT

Uniform turning movement is very important where alternators are to be run in parallel as the variation in angular velocity, such as occurs in either simple or tandem compound engines, sets up cross currents which cause heating of the generator armatures and interfere with the regulation.

Positive Ventilation is the title of a folder illustrating the devices made by the Garner Ventilating Co., 140 Liberty street, New York, and 115 Dearborn street, Chicago. These devices consist of a machine constructed so that it can be placed on the window sill, the fresh air being supplied by means of a duct leading through a panel under the window directly behind the machine. The machine itself consists of a centrifugal fan connected directly on a shaft of an electric motor which derives its power through an electric cord attached to any lamp socket. A connection with the steam or hot water pipes furnished the heat for the radiating surface within. This device is made in two sizes, 17 x 14 x 10 in. and 30 x 30 x 46 in.

A Combined Valve Gear for Feed Water Heaters and Receivers

In the construction of apparatus requiring occasional cleaning, it is, of course, an immense advantage, if possible to provide some means for doing this without closing down the apparatus itself. In the case of a large feed water, such as the Cochrane steam stack and cut out valve type, where an extra large separator is attached to and forms a part of the heater, manually controlled valves were formerly provided to shut off the separator from the heater body and to close the passage between the separator trap and the overflow of the heater.

To enable both valves to be closed when it is desired to cut out the heater and to provide against accidental opening of the valve while the heater is being cleaned, it was found practicable, on small heaters, to connect the spindles of the two valves and to turn them by a single lever (Fig. 1).

Where a pressure of 5 lbs. per square inch or more is carried in the heating system, the total pressure over the valve of a large feed water heater would rend-

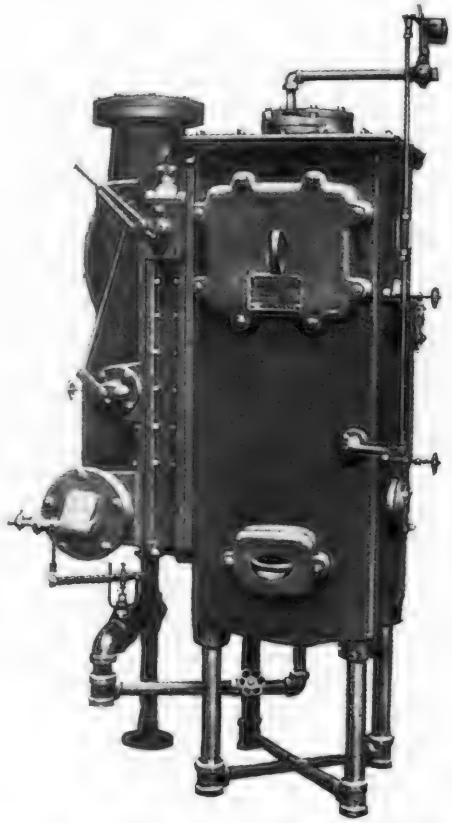
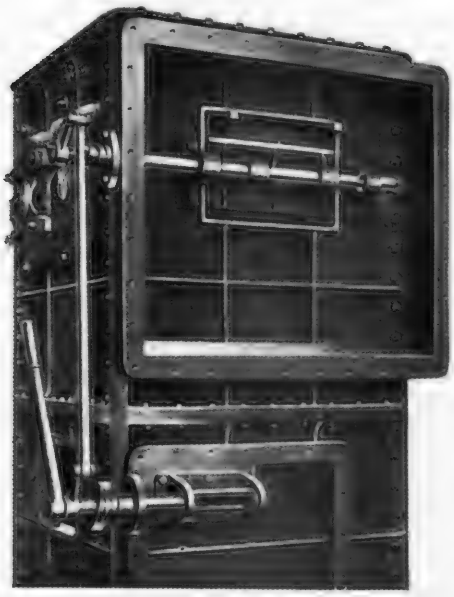


FIG. 1. ARRANGEMENT OF COMBINED VALVE GEAR FOR SMALL FEED WATER HEATER AND RECEIVER

er operation difficult. To overcome this, a special valve gear has been devised, the operating handle being attached to the spindle of the lower valve. The lower end of the connecting rod engaging the pin on the short crank of the lower spindle has a certain excess of motion over that of the upper spindle.



Upper Valve Closed. Lower Valve About to Close

FIG. 2. OPERATION OF COMBINED VALVE GEAR FOR CLOSING LARGE OPEN FEED WATER HEATER AND RECEIVER

This excess motion results in the upper valve shutting off first (Fig. 2), remaining thus while the lower valve rotates through the remaining arc of its motion. The purpose of this is to insure that the larger valve will not be subject to unbalanced steam pressure when being moved.

After the lower valve closes, cutting off the heater, any steam contained in the heater will be condensed or will escape from the vent pipe. Once both valves are closed the operating handle may be removed. In opening the valves again, the lower valve will admit steam through the separator pipe and trap into the heater, equalizing the pressure on the steam valve before the latter begins to move.

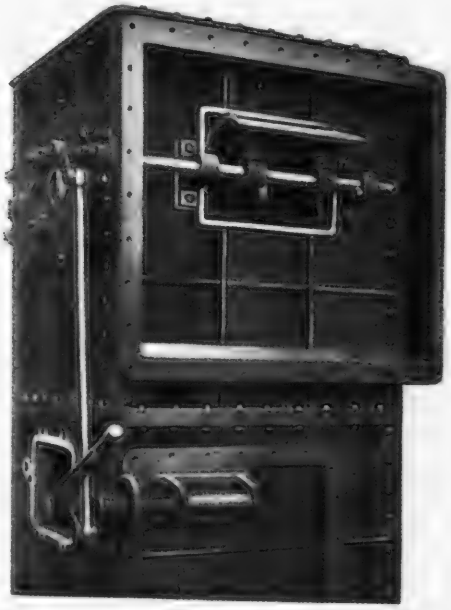
During this operation, the valve in the vent pipe should be closed to permit pressure to build up in the heater when the lower valve is first opened.

A Type of Modern Catalogue

It has become almost the invariable practice with concerns of any size to issue bulletins from time to time, instead of the old expensive catalogues which might very soon become out of date. The average bulletin, however, is often a very cheap, flimsy affair which makes no appeal to the artistic sense and seldom contains any data which will be of service except with reference to the particular machine or appliance described.

Something new in this type of catalogue has been devised by the Wisconsin Engine Co., Corliss, Wis., and the idea will be found useful by those engaged in the preparation of trade literature as well as by those who consult them. The scheme, which has been well carried out, was to produce something up to the best standard of catalogue work, but issued in the form of a bulletin, something which would be a pleasure to read and keep and which would contain data of real interest pertaining to the general subject discussed.

The cover, therefore, was made up so as to accommodate future bulletins which will be punched to fit the staples inside the cover. Many men file such matter vertically, sometimes on their desk tops,



Upper Valve Open. Lower Valve About to Open.

FIG. 3. OPERATION OF COMBINED VALVE GEAR FOR OPENING LARGE OPEN FEED WATER HEATER AND RECEIVER

and have their private filing marks. Three white spaces on the outside binding edge of the cover permit these marks to be readily put on and matter pertaining to the subject covered, in this case, steam engines, can be easily reached at a moment's notice.

The cover is made with the back page extending ¼ in. beyond the edge of the front cover. This "slack" will be taken up as future bulletins are inserted. The arrangement adopted permits of the design of a handsome cover as it will re-

main a permanent part of the catalogue. In this particular instance, the cover is a well-executed reproduction of a heavy duty Corliss engine of the belted type, done in blue and white. The size of the catalogue is 8 x 10 in.

Trade Notes

Watson-Stillman Twinvolute Turbine Pump, for house tank service and sump drainage, is described, with illustrations, in a recent folder issued by the Watson-Stillman Co., 50 Church Street, New York. The illustrations show a 2½ in. single stage pump and 7 H.P. direct current motor with a capacity of 150 gals. per min.; also the two stage type (for lifts of over 100 ft.) for direct and alternating current, and with capacities of 25 gals. per min. For sump drainage, the Twinvolute pumps are made in all sizes for both vertical and horizontal operation.

Gould's Efficient Triplex Power Pumps, made by the Goulds Mfg. Co., Seneca Falls, N. Y., are the subject of a comprehensive little catalogue, containing in small compass, the desired information regarding the company's line of pumps. Illustrations, together with sizes and capacities of various types of Goulds single-acting and double-acting triplex plunger pumps are included, showing their adaptability for boiler feed purposes, hydraulic elevator service for city water works and for other uses. Pp. 32. Size 3½ x 6 in. (standard).

Merriam Vertical Gas Engines, for electric lighting, pumping and general power purposes, made by the Bruce-Macbeth Engine Co., Cleveland, Ohio, are described in a handsome new catalogue. The Bruce-Macbeth Engine Co. is a consolidation of the Bruce-Merriam-Abbott Co. and the Macbeth Iron Co. The catalogue opens with a discussion of the development of gas engines in general and shows the advantage of the four stroke cycle principle employed in the construction of the Merriam four cylinder gas engines. The various parts are shown in photographic detail and typical installations are included for generating electric current, producer gas and for general power work, for capacities ranging from 75 to 300 H.P. Pp. 32. Size 8 x 10 in.

Heavy Duty Corliss Engines, belted type, are the subject of a unique catalogue, the arrangement of which is referred to elsewhere in this issue, published by the Wisconsin Engine Co., Corliss, Wis. The catalogue opens with a review of the present development of the Corliss type of engine and special attention is called to the higher speed Corliss engines built by this company. The illustrations are engraved and reproduced with a care seldom excelled even in catalogue work and the various parts, as designed by this firm, are shown in phantom and plan views. Included in the catalogue is a rule for estimating the size of a compound engine, which is reproduced herewith through the courtesy of the Wisconsin Engine Co. To get the approximate size of a compound engine

VERTICAL CENTRIFUGAL PUMP FOR SUMP DRAINAGE

assume a boiler pressure and allow for 5 lbs. to 10 lbs. drop before reaching the throttle; using this figure as the steam pressure, select the corresponding M. E. P.—for non-condensing or condensing, as the case may be; assume a piston speed and get the diameter of the low pressure cylinder as follows:

$$\text{Area L. P. Cylinder} = \frac{\text{Indicated Horse-power} \times 33{,}000}{\text{Piston Speed} \times \text{M. E. P.}}$$

$$\text{Diameter Cylinder} = \sqrt{\frac{\text{Area}}{.7854}}$$

$$\text{Area H. P. Cylinder} = \frac{\text{Area L. P. Cylinder}}{\text{Cylinder Ratio}}, \text{ or}$$

$$\text{Diameter H. P. Cylinder} = \frac{\text{Diameter L. P. Cylinder}}{\sqrt{\text{Cylinder Ratio}}}$$

Thus, for 1,400 I. H. P. with 160 lbs. boiler pressure, condensing at 26 in. vacuum, take 150 lbs. throttle pressure, M. E. P. of 27.5, cylinder ratio 4-1, and a piston speed of 920 ft. per minute.

$$\text{Area L. P. Cylinder} = \frac{1{,}400 \times 33{,}000}{920 \times 27.5} = 1{,}830 \text{ sq. in.}$$

$$\text{Diameter} = \sqrt{\frac{1830}{.7854}} = 48.4 \text{ in. say } 48 \text{ in.}$$

$$\text{Diameter H. P. Cylinder} = \frac{48}{\sqrt{4}} = 24 \text{ in.}$$

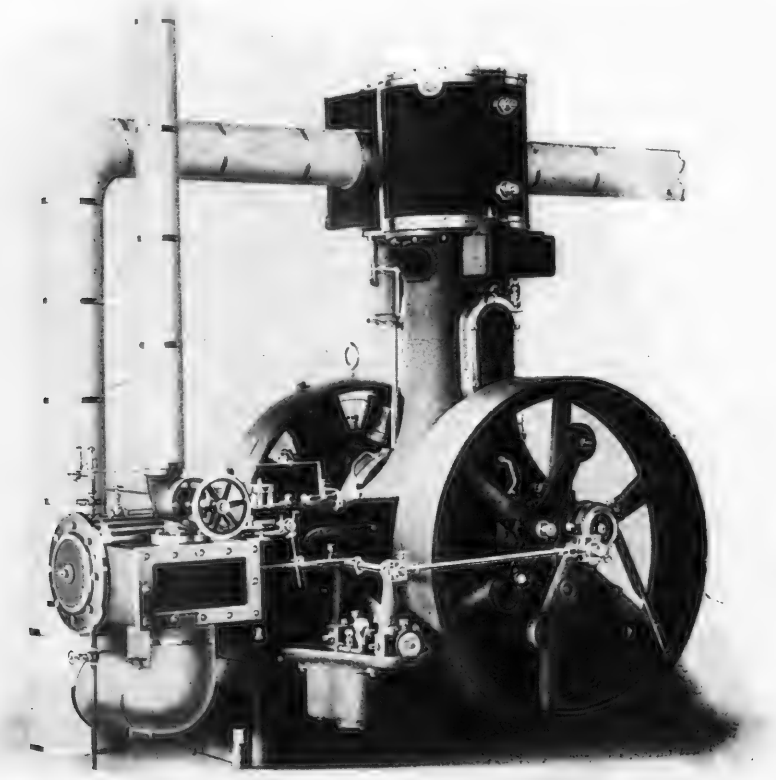
Engine size 24/48 x 48, running at 115 R. P. M. will indicate about 1,380 H.P. at most economical load.

The I. H. P. of an engine for direct connected electric generator service is usually taken as one and a half times the full load K. W. output of the generator —I. H. P. = 1.5 x K. W.

Load conditions sometimes warrant a considerable departure from standard sizes, and we will be very glad to make suggestions based on a load curve analysis.

American Engine Co., Bound Brook, N. J., has perfected designs of the American angle compound engine for small high-speed units of from 100 to 500 H.P. to run at speeds of 250 to 325 R. P. M. and for condensing or non-condensing service. These engines have been found to be suitable for any class of service but are especially adapted for isolated plant work, such as carrying hotel, apartment house, and office lighting loads. For this purpose their freedom from vibration especially recommends them.

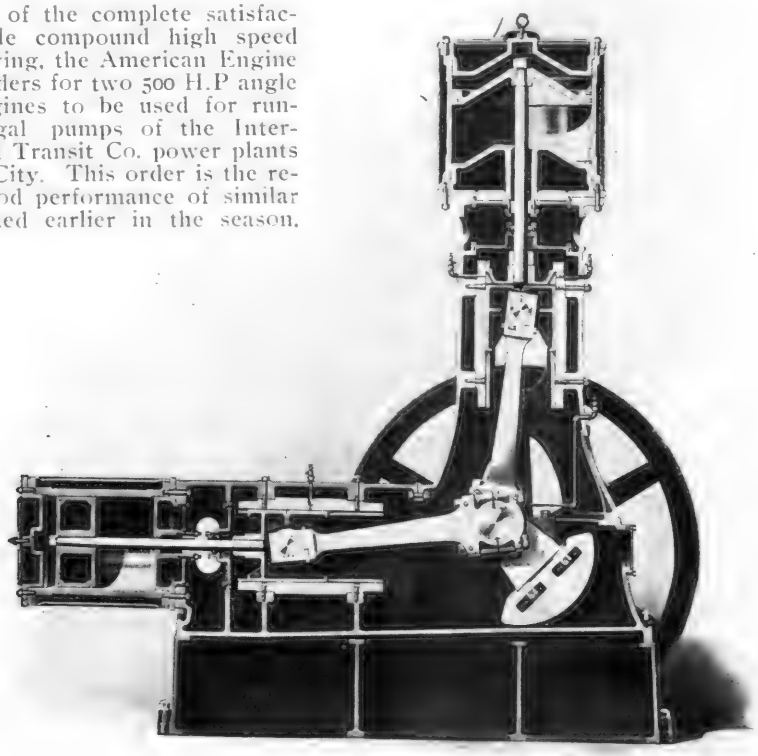
It has been suggested that small turbines might be used for isolated plant work, but, as has recently been pointed out, small turbines are not economical, especially when running non-condensing. In fact, small turbines consume between 50 and 70 lbs. of steam per H.P. hour when exhausting to the atmosphere, whereas one of the angle compound engines, if supplied with steam at the same pressure, will furnish an H.P. hour on



COMPLETE AMERICAN BALL ANGLE COMPOUND DIRECT CURRENT GENERATING UNIT

25 lbs. A small-sized turbine to be run as economically as this would have to exhaust to a high vacuum. This introduces the extra complication and expense of condensers and air pumps and leaves no exhaust steam available for heating, which is generally desirable in isolated plants.

As evidence of the complete satisfaction that angle compound high speed engines are giving, the American Engine Co., reports orders for two 500 H.P angle compound engines to be used for running centrifugal pumps of the Interborough Rapid Transit Co. power plants in New York City. This order is the result of the good performance of similar engines installed earlier in the season.



CROSS SECTION OF AMERICAN BALL ANGLE COMPOUND ENGINE SHOWING RELATIVE POSITIONS OF CONNECTING RODS AND COUNTERBALANCE WEIGHT

Bloomingdale Brothers have installed a 400 H.P. engine of the same type, and the three lighting units installed in the Belnord Apartments are now in continuous operation.

Foxboro Recorder for October, 1909, published by the Industrial Instrument Co., Foxboro, Mass., contains illustrated descriptions of the inner workings of the company's latest types of gauges, known as Model A and Model B. Tachometer construction is the subject of an article and there is also a description of electrically heated oil filters, which are among the company's product, the process being that of "washing" the oil in hot water.

J-M Brickline Asbestos Firebrick Cement, for setting up bridge walls and inner courses of furnaces, are described in a circular published by the H. W. Johns-Manville Co., New York. This material is a high refractory cement of semi-liquid consistency, prepared for immediate application in setting up firebrick in every kind of service. It fuses under heat, serving to bind the whole mass together and, under intense heat, vitrifies into a hard glaze, coating the bricks. Price lists are included in the circular, showing the cost of brickline to range from 5 to 7c., depending on quantity.

Henry A. Bogardus & Co., Chicago, manufacturers of gauges and valves, announce that according to the new street numbering plan for Chicago, which went into effect September 1, 1909, the company's new street number is 159 West Huron Street. M. B. Hicks, formerly with the American Steam Gauge & Valve Mfg. Co., Boston, is now connected with the sales department of Henry A. Bogardus & Co.

New Books

Transactions of the American Institute of Chemical Engineers, Volume 1, has been received, containing, in addition to the papers read before the society's initial meeting in Pittsburg last

December, a record of the steps that led to the formation of this body, together with the society's constitution, by-laws and list of members. The papers alone are of a character and scope that make the volume an impressive record of the virility of this young organization. Among the papers of special interest to heating engineers are "Steam Power Plant Economies," by William Miller Booth; "Testing and Performance of Steam Generating Apparatus," by A. Bement; "The Examination of Flue Gases in Boiler Tests," by H. August Hunicke; and "Calculations for Dryer Design," by William M. Grosvenor (published in THE HEATING AND VENTILATING MAGAZINE for May and July, 1909). The book is published by the D. Van Nostrand Co., 23 Murray Street, New York. Pp. 204. Size, 6 x 9 in. Price, $6.00 net.

Architects' Directory and Specification Index for 1909, published by William T. Comstock, 23 Warren Street, New York, is out, containing a list of the architects of the United States, Canada, Cuba and Porto Rico, classified by States and towns; also landscape and naval architects of the United States and Canada, architectural societies and organizations of the world, architects of the boards of education in the principal cities of the United States and Canada and officers of the building departments in the principal cities. The specification index includes those of prominent dealers and manufacturers of building materials and appliances. Pp. 212. Size 7 x 10 in. Price $3.00 net.

Vermont Adopts Heating and Ventilating Requirements

According to regulations adopted by the State Board of Health of Vermont, September 20 last, the Green Mountain State has placed itself in line with Massachusetts, New Jersey, New York and Pennsylvania in the heating and ventilating requirements for schools or "schools and other public buildings," in force in these States.

The Vermont requirements apply to school houses, hospitals and other public buildings, but public buildings, as defined by the State laws, include churches, school buildings, hotels more than two stories high and places of amusement, more than one story high, and buildings, factories, mills or workshops more than two stories high in which persons are employed above the second story. This act, Chapter 225, entitled, "Preservation of Public Health," in which "public buildings" are defined (Section 5412) also contains the authority under which the State Board of Health is empowered to make regulations regarding heating and ventilating, as well as lighting and sanitation.

Following are the new heating and ventilating requirements:

a. The heating apparatus must be of sufficient capacity to warm all rooms to 70° F. in any weather.

b. With the rooms at 70°, and a difference of not less than 40° between the temperature of the outside air and that of the air entering the room at the warm air inlet, the apparatus must supply at least 30 cu. ft. of air per minute for each person accommodated in the rooms.

c. Such supply of air should so circulate in the rooms that no uncomfortable draft will be felt, and that the difference in temperature between any two points on the breathing plane in the occupied portion of the room will not exceed 3°.

d. Vitiated air in amount equal to the supply from the inlets should be removed through the ventiducts.

e. The closets and fixtures must be so arranged and ventilated that no odors therefrom will be perceived in any portion of the building.

To secure the approval of the State or local health officials of plans showing methods or systems of heating and ventilation, the afore-mentioned requirements must be guaranteed in the specifications accompanying the plans. In schoolhouses, hospitals and other institutions, the number of occupants intended for each room should be given, and in places of assemblage the arrangement of seats and aisles should be shown on plans.

As 40 pupils are as large a number as one teacher can well instruct, the rooms, it is specified, shall be 32 x 28 x 12 ft. high, giving from 200 to 300 cu. ft. of air space and 20 sq. ft. of surface area for each pupil.

The windows must be numerous, large enough, and so arranged as to give ample light to every part (and corner) of the room. The window space should be one-fourth of the floor space, and must be not less than one-fifth. There must be no more space between the top of the window and the ceiling than is required to finish the building, and the window sill must be 4 ft. from the floor.

A Course in Journalism

New York University, Washington Square, East, New York, announces the inauguration of a Department of Journalism in the School of Commerce, Accounts and Finance. "Trade and financial journals," says the official announcement of the department, "have become within recent years a powerful force in business life. There still remain great opportunities for expansion and improvement, and a career in this field should appeal strongly to persons who possess ability and the right kind of training. It is believed that the School of Commerce, Accounts

and Finance, in connection with the Department of Journalism, can now offer a remarkable comprehensive and efficient training for such work." Afternoon and evening classes are scheduled, to continue through the college term. A bulletin descriptive of the course may be had by addressing the university.

NEW DEVICES

The Moeller Air Filters

A type of air purifier that has met with considerable success abroad and is about to be introduced in this country is made by the K. & Th. Moeller, of Brackwede, Westphalia. It is a cloth device, known as the Moeller pocket frame air filter. The manufacturers report that 1,800 of these filters have been installed, with a total output of 12,000,000 cubic meters of air per hour. In some of these installations filters are provided with a capacity of passing as much as 240,000 cu. ft. of air per minute. The company has been manufacturing air filters since 1879, and its patent covering the presen type of apparatus was filed in the U. S. Patent Office August 10, 1909, being No. 930,561.

An idea of the construction of the Moeller air filter may be had from the accompanying illustrations. In the design of cloth air filters, the leading fundamental principle is to bring into the smallest possible compass the largest possible filter area, and, while following this principle, two conditions must be filled, namely, unobstructed entrance and exit of the air, and absolute air tightness between the filter fabric and the chamber walls. In front of or within the supply duct of the air to be cleaned, a frame is inserted across the direction of the air current. A fabric is stretched upon this frame in such a manner that the air is forced to penetrate it. To get a large filtering area the fabric is not arranged in a simple plane covering the frame, but is formed in the shape of pockets that are held taut by special contrivances. This arrangement allows the storing of an area up to forty times that of the opening of the frame.

FIG. 1. TYPICAL INSTALLATION OF MOELLER AIR FILTERS

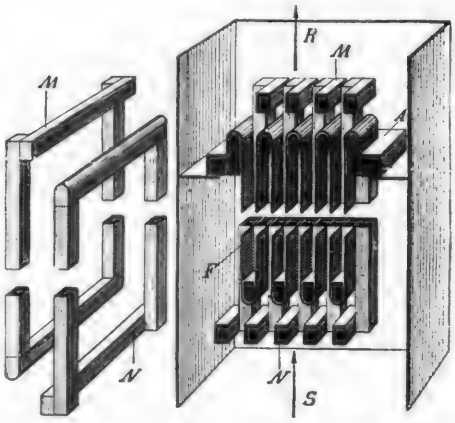


FIG. 2. DESIGN OF MOELLER AIR FILTER

The suspended particles of dust are retained on the outside surface of the pockets, whence they fall off or are shaken off.

In the construction of the Moeller pocket frame air filter, a frame A, carrying the filter proper, is built in a cross wall of the air duct. The permeable filter fabric F consists in this filter of one single piece of a certain width and length, and is folded alternately over the frames M and N in such a manner that pockets are formed as shown in Fig. 3. The cloth is fastened at its two narrow ends. By shifting the frame M downward and the frame N upward, the cloth is stretched.

The battens of the frame that do not come into contact with the cloth, that is, the upper horizontal one in frame M and the lower horizontal one in frame N, are arranged sideways out of plane with the rest of the frames to give free passage to the air and to allow convenient access for cleaning the filter without taking it apart. The frames are made air tight by pressing them together.

The air penetrates the filter from below. It is forced to go through the cloth which deprives it of the dust it carries. The filter cloth F lies, as described, ser-

pentlike between the pocket frames M and N. The right-hand side of the apparatus is shown pulled apart. The two ends of the cloth are held fast on the outer pressure frames O by the cloth clamping rails. This clamping device is such that the cloth is not injured and a reserve length of it is provided for. The extra lengths at the ends are stored away in recesses of the pressure frames.

Air tight joints between the set of frames and the main frame are made with felt packing. Since the aggregrate thickness of the frames varies somewhat with the compression, one side of the main frame is made adjustable or the clearance may be taken up with filling wedges.

The filter can be furnished for installing directly into prearranged filter chambers or with suitable housings. The latter may consist of a wooden box enclosing the whole filter or enclosing only the clean air space.

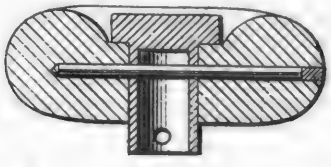
In large filters the cloth is not run continuously through the whole number of frames forming a battery, but is divided into convenient lengths for two or more elementary sets of frames. These may be supported in a common main frame or in several frames tightly connected, according to the size and capacity of the whole plant.

The dust caught by the air filter drops off and collects at the bottom of the dust air space. A portion of it, however, sticks to the surface of the fabric and must be removed from time to time. This can be done by beating, brushing or vacuum cleaning about every three months. After some years' use it may be thoroughly cleaned and renewed by washing.

Further information regarding the Moeller air filters may be had from Messrs. Lenz & Molé, 71 Broadway, New York.

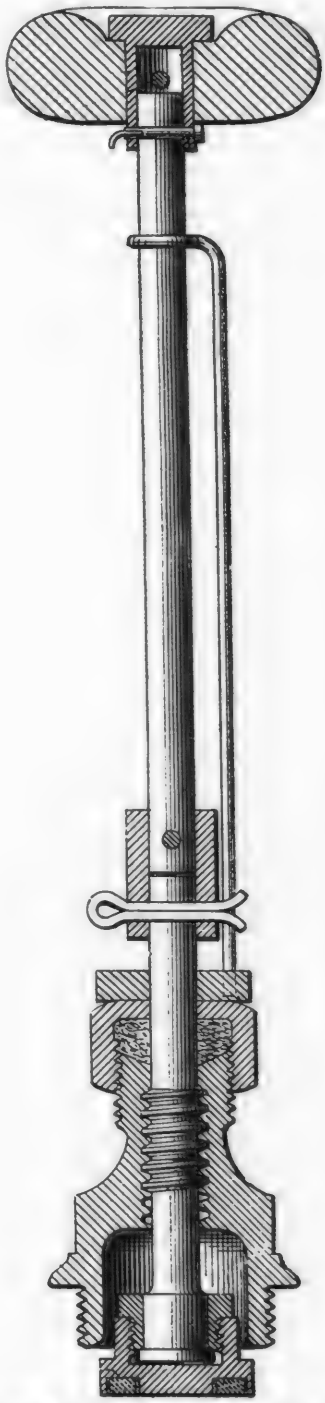
A New Extension Spindle Valve

A new type of extension spindle for a valve has been patented by J. O'Meara, 82-84 Centre Street, New York, manufacturer of valves, valve discs, valve



HANDLE OF NEW EXTENSION SPINDLE VALVE

wheels, etc., and is illustrated herewith. The interesting features of this device, in addition to the extended stem, is the manner in which the wheel is attached, having a blind fastening composed of a socket inserted in the wheel from the face side and a concealed pin inserted transversely through the wheel and socket for connecting them. The false nut in the top of the wheel is designed to give the valve the appearance of those in commercial use, although the cost of construction with the concealed pin is materially lessened. The O'Meara heating specialties, including the exten-



NEW EXTENSION SPINDLE VALVE

sion spindle valve, have been installed in many of New York's principal buildings, including the Metropolitan tower, Chelsea Docks; also in the West Point Academy buildings and in the Prudential Insurance Company's buildings in Newark, N. J. The Canadian patent for the O'Meara extension spindle valve is for sale. Further information may be had by addressing THE HEATING AND VENTILATING MAGAZINE.

Progress Boilers, Series D, are a new line of this well-known type of heater, manufactured by the Thatcher Furnace Co., New York. This series includes capacities from 6,000 to 16,000 sq. ft. steam radiation and from 10,000 to 24,000 sq. ft. water radiation. A feature of this boiler of special advantage where the load is liable to fluctuate, is the method provided for cutting out a portion of the boiler from service by a valve, which renders each portion of the boiler separate from the other.

The Weather for September, 1909

Slightly cooler weather than usual prevailed in many parts of the country during September than for the corresponding period a year ago. In the Eastern sections, however, the temperature was practically normal.

NEW YORK

Highest temperature, 79°, on the 3d; lowest temperature, 48°, on the 29th; greatest daily range, 23°, on the 3d; least daily range, 4°, on the 10th. Mean temperature for the month, 66°, corresponding to the mean of this month for 39 years. Total precipitation for the month, 2.66 in., almost 1 in. less than usual. Total movement of wind, 7,335 miles, mostly from the northwest.

BOSTON

Highest temperature, 82°, on the 3d; lowest temperature, 46°, on the 20th; greatest daily range, 28°, on the 3d; least daily range, 4°, on the 26th. Mean temperature for the month, 63°, corresponding to the mean of this month for 39 years. Total precipitation, 5.15 in., nearly 2 in. more than usual. Total wind movement, 6,093 miles, mostly from the east.

PITTSBURG

Highest temperature, 87°, on the 13th; lowest temperature, 39°, on the 28th; greatest daily range, 31°, on the 6th; least daily range, 11°, on the 30th. Mean temperature for the month, 65°, 2° below the mean of this month for 39 years. Total precipitation, 0.76 in., the average of this month for 39 years being 2.40 in. Total wind movement, 6,302 miles, mostly from the north.

CHICAGO

Highest temperature, 89°, on the 13th; lowest temperature, 47°, on the 28th; greatest daily range, 20°, on the 28th; least daily range, 3°, on the 26th. Mean temperature for the month, 64°, 1° below the mean of this month for 39 years. Total precipitation, 3.60 in., about ½ in. more than usual. Total wind movement, 8,707 miles, mostly from the northeast.

ST. LOUIS

Highest temperature, 92°, on the 3d; lowest temperature, 43°, on the 27th; greatest daily range, 29°, on the 3d; least daily range, 10°, on the 7th. Mean temperature for the month, 68°, 2° below the mean of this month for 37 years. Total precipitation, 4.22 in., about 1.25 in. more than usual. Total wind movement, 6,259 miles, mostly from the southeast.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Annual Meeting of Illinois Chapter

At the annual meeting of the Illinois Chapter, American Society of Heating and Ventilating Engineers, the following officers were elected for 1909-10:

President, Edmund F. Capron; vice-president, N. L. Patterson; treasurer, August Kehm; secretary, John F. Hale.

Board of governors: R. A. Widdicombe, James Mackay, J. P. Dugger.

The reports made by the secretary and treasurer and the board of governors showed a very healthy condition of this body, and from the attendance at this first meeting of the year, it is clear that the interest in the chapter's affairs still continues, and a prosperous year is looked for.

There are a number of interesting papers in course of preparation, and several of the meetings during the present year will probably be of a public nature, with speakers of prominence in the engineering world.

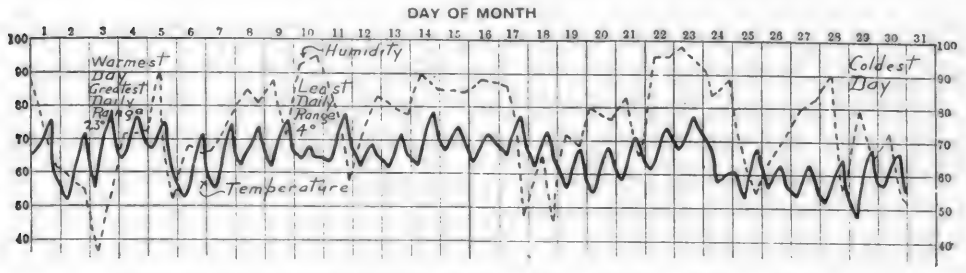
NATIONAL ASSOCIATION OF MASTER STEAM AND HOT WATER FITTERS

Dinner of Newark (N. J.) Local Association.

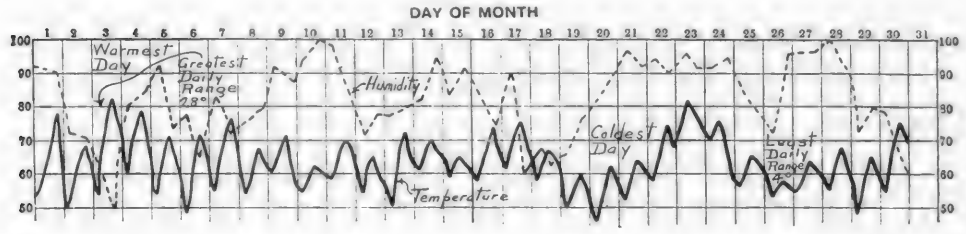
The fifth annual dinner of the Newark (N. J.) Association of Master Steam and Hot Water Fitters' Association will take place December 8, 1909, at Davis' Restaurant, 943 Broad Street, Newark. The dinner will be served at 6 P. M. and has been arranged for at $3.50 a plate. The entertainment committee is composed of Sol. Berla, William M. Whitlock and Robert Berla.

Institution (British) of Heating and Ventilating Engineers

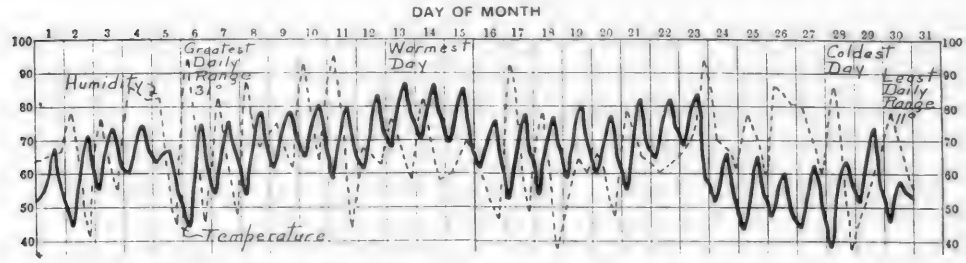
At the autumn meeting of the Institution of Heating and Ventilating Engineers, held in London, October 5, two



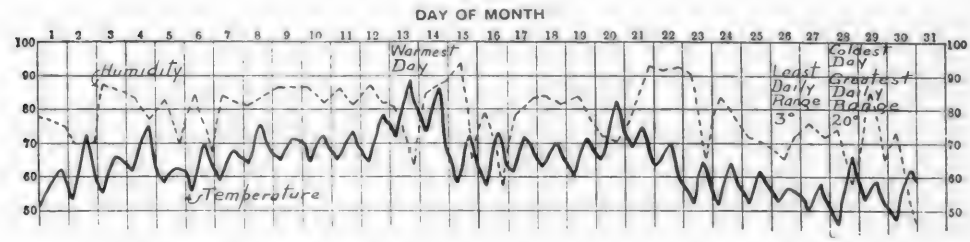
RECORD OF THE WEATHER IN NEW YORK FOR SEPTEMBER, 1909



RECORD OF THE WEATHER IN BOSTON FOR SEPTEMBER, 1909



RECORD OF THE WEATHER IN PITTSBURG FOR SEPTEMBER, 1909



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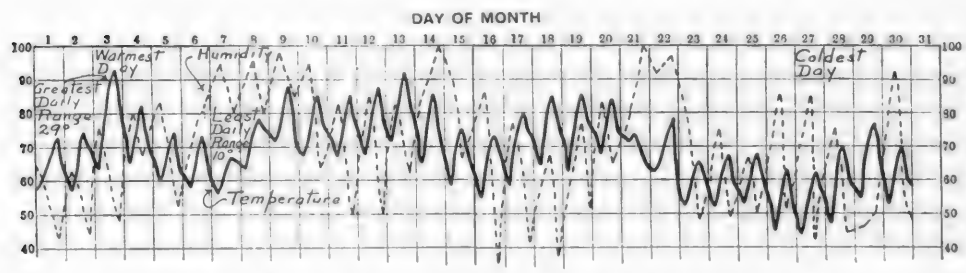


RECORD OF THE WEATHER IN ST. LOUIS FOR SEPTEMBER, 1909

papers were read, one by F. B. Craig, of Manchester, on a hospital heating plant using hot water under forced circulation, and another by Oswald Stott, of Birmingham, entitled "A Few Thoughts About Fans." In accordance with the recently adopted policy of this society, these papers are not given out for publication in full. The main points of both papers are presented elsewhere in this issue.

C. I. Haden, the present vice-president of the institution, was nominated for president for 1910, and A. H. Barker was nominated for vice-president. The election will take place at the annual meeting in London, February 15, 1910.

The date of next summer's meeting was fixed for June 21 for the convenience of those intending to attend the joint meeting of the Institution (British) of Mechanical Engineers and the American Society of Mechanical Engineers, which will be held in England July 25-29, 1910. This will enable American engineers interested in heating and ventilation who attend the joint meeting to participate in the proceeding of the British heating engineers' society.

Efforts the society has been making to induce the English institutions of learning to inaugurate courses in heating and ventilation have resulted in a scheme proposed by the London University to enable students taking the university's three-year course in engineering to specialize during the third year in heating and ventilation.

Joint Meeting of American and English Mechanical Engineers in London in 1910

Acting on an invitation received from the Institution (British) of Mechanical Engineers, the American Society of Mechanical Engineers is arranging to hold a joint meeting of these two bodies in London, during the summer of 1910. The meetings will begin July 26 and conclude July 29. Among the additional inducements that will attract American engineers to the joint sessions are the meeting in June, 1910, of the Institution (British) of Heating and Ventilating Engineers. Interesting special exhibitions are also to take place in Brussels, Dusseldorf and other cities, and the Passion Play will be produced next year at Oberammergau for the first time in ten years. The American exposition in Berlin will be held during May, June and July of 1910.

Charles V. Anderson, of *The Drygoodsman*, St. Louis, Mo., was elected president of the Trade Press Association, at its recent meeting in New York, succeeding David Williams, of the *Iron Age*, who retires from business life after a career of 54 years.

Current Heating and Ventilating Literature

Under this heading is published each month an index of the important articles on the subject of heating and ventilating that have appeared in the columns of our contemporaries. Copies of any of the journals containing the articles mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

EVAPORATION, VACUUM

Vacuum Evaporation. P. B. Sadtler. Jl of Ind & Engg Chem—Sept., 09. Deals with the design and utilization of closed evaporators in which saturated steam is the heating medium. 4 figs. 7,300 w. 80c.

FANS

Capell's Centrifugal Fan. Illustrates and describes recent improvenemts made in this fan. 1,000 w. Mech Engr—Sept. 17, 1909. 40c.

Electrically-Driven Fans. George W. Baird. Gives tabulated report of tests and general information. 1,500 w. Jour Am Soc of Nav Engrs—Aug., 1909. $1.60.

HEAT EQUIVALENT, MECHANICAL

The Absolute Value of the Mechanical Equivalent of Heat in Terms of the International Electrical Units. H. T. Barnes. Elecn—Aug. 20, 1909. Abstract of paper read before the Faraday Society. 1,100 w. 40c.

HOT-WATER HEATING

Design of a Central Heating System with Forced Circulation of Hot Water. Joseph T. Maguire. Discusses the design of a forced-circulation, central, hot-water heating system. 3,000 w. Eng. News—Sept. 2, 1909. 20c.

MECHANICAL PLANTS

The Electrical and Mechanical Installation in the Hotel La Salle. Howard Ehrlich. Illustrated description of the equipment of Chicago's newest and largest hotel. 3,000 w. Elec Rev, N Y—Sept. 4, 1909. 20c.

PIPE-THREADING MACHINES

Modern Machines for Pipe Threading. J. F. Springer. Power—Aug. 17, 1909. Discusses early methods of threading; development of the die, its adaptability and taper; typical examples of modern pipe-threading machines, etc. 23 figs. 5,000 w. Sept. 7. 17 figs. Describes large pipe-threading machines embodying the latest improvements and some examples of hand threading in inaccessible places. 3,900 w. each. 20c.

PIPE DESIGN

The Design of Pipes. T. E. Thain. Pract Engr—Aug. 20, 1909. 1 fig. 500 w. Aug. 27, 6 figs. Gives formulas for the calculation of the proper sizes for steam pipes. 2,800 w. Each 20c.

STEAM DIAGRAMS

The Solution of Steam Problems by the Use of a Diagram. Lionel S. Marks. Eng News—Aug. 26, 1909. Gives a large 3-color folding total heatentropy diagram, based on the recent investigations of Knoblauch and Jacob, Thomas, Henning, and others, and describes its use in the rapid solution of steam problems, with numerical examples. 1 fig. 5,500 w. 20c.

VENTILATION

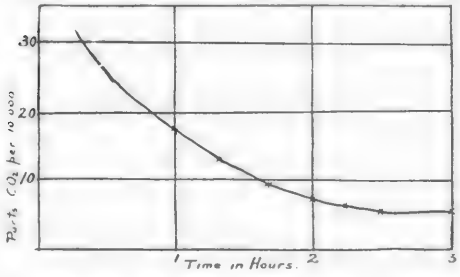
Heating, Cooling and Humidifying. Sterling H. Bunnell. On methods of producing any desired conditions either automatically controlled or under the management of an engineer. 2,500 w. Ind Engng—Sept. 15, 1909. 40c.

Plaster as an Absorber of the Sulphur Released by Burning Illuminating Gas

In connection with recent experiments relating to the amount of sulphur gases introduced into rooms through the burning of illuminating gas, the Arthur D. Little, Inc., Laboratory of Engineering Chemistry, Boston, Mass., gives some interesting facts which have an important bearing upon health.

A room was arranged for a series of tests by rendering it practically air-tight and installing within fans for stirring up the air and for exhausting it at a rate to maintain the desired degree of ventilation. The room was plastered as is usual in dwelling houses, the walls being papered and the ceiling calcimined.

The object of the experiments was to find out to what extent the burning of illuminating gas increased the amount of sulphur gases, while ventilation was maintained at the usual standard of air purity. The rate of disappearance of



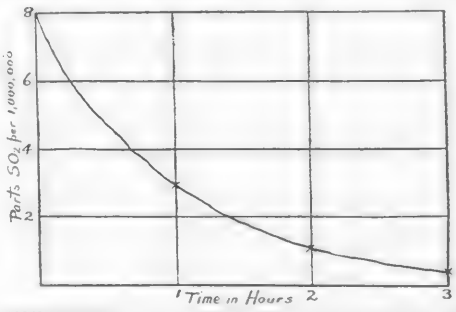
RATE OF DISAPPEARANCE OF CARBON DIOXIDE

carbonic acid gas was determined by liberating a known quantity and then analyzing samples of the air at 15-minute intervals. The results are shown in the accompanying curve, Fig. 1, which indicates the rate of disappearance due to the exhausting of the air and the inleakage of fresh air.

A known quantity of sulphur dioxide was then liberated under the same conditions of ventilation. The mean value for the sulphur dioxide content for the three hours is shown by the horizontal straight line of Fig. 2; the curve of Fig. 2 being the theoretical rate of disappearance of sulphur dioxide calculated from the known degree of ventilation, assuming sulphur dioxide to disappear at the same rate as the carbon dioxide.

But the sulphur dioxide did not disappear at the same rate; in fact, the analysis showed that at the end of three hours there was but 9% of the sulphur gases that would have been present had they been removed only by changing the air.

The room was then sealed more securely and the exhaust fan run at reduced speed in order that the escape of vitiated air might be slower. The ex-



THEORETICAL RATE OF DISAPPEARANCE OF SULPHUR DIOXIDE

periments were then repeated. By calculation, it was found that the rate of change of air for good ventilation was a little over five times as great as for poor ventilation, and analysis showed that the percentage of carbonic acid gas was about five times as great for poor ventilation as for good. Not so with the sulphur dioxide. Instead, the amount of sulphur dioxide was only one-third the amount calculated to have entered with the gas, allowance being made for its disappearance due to the exhausting of the air to provide ventilation.

It was apparent that the sulphur was absorbed in the plaster, and scrapings from the plaster ceiling were shown to contain sulphur. After experiments had been made with good ventilation and with poor ventilation, and with a comparatively large percentage of sulphur dioxide, and also with a small percentage due to burning illuminating gas, it was evident that the greater the sulphur dioxide content the faster it was absorbed by the plaster, a fact expected by the expert chemists. This is important, for the plaster acts as a check on an increase of sulphur.

The ceiling of the room was then papered and the experiments repeated under the same conditions of ventilation. It was found that while the paper reduced somewhat the effectiveness of the plaster in absorbing the sulphur, yet it was sufficiently porous to interfere but

little with the reaction between plaster and sulphur.

Analyses of plaster scraped from the surface and near the lath, together with calculations, show that sulphur is quickly absorbed at the surface and that the plaster on a 10 x 18-ft. ceiling will neutralize for several centuries the sulphur coming from the burning of 25 cu. ft. of gas per day, when the gas contains 20 grains of sulphur per 100 cu. ft.

Terms For Expressing Air Movements

As wind velocities are usually expressed in terms of miles per hour and air movements as used in heating and ventilating work in ounces of pressure, feet per minute or inches of water, the following comparative table may be found handy for use when figuring outside and inside air velocities:

AIR MOVEMENTS.

Miles per Hour	Ounces Pressure	Feet per Minute	Inches Water	Character
2	...	175.2	....	.....
3	...	262.8	....	.....
4	...	351	....	.....
5	...	439.2	....	.....
10	...	880.8	....	.....
12.5	...	1098	....	Brisk
25	...	2196	...	Very brisk
30	¼	2585	0.43	.....
35	...	3090	....	High wind
41.4	½	3658	0.87	.....
45	...	3960	...	Very high wind
47.6	⅝	4084	1.07	.....
50.8	¾	4472	1.3	.....
59.8	1.0	5161	1.7	.....
60	...	5280	....	Strong gale
65	1.25	5768	2.2	.....
71.7	1.5	6315	2.6	.....
80	2.0	7284	3.5	.....
100	3.0	8903	5.2	.....

Ventilating System for Sleeping Cars

The Pullman Car Company has adopted a new system of ventilators for sleeping cars, which will make the raising of window screens unnecessary. The new system was perfected by Thomas Garland, general agent of the Burlington's refrigerator service, and will be installed on more than 4,000 cars being built for the various railroads.

The new system provides for extending a duct from the roof of the car down the side and opening into the car near the level of the lower berth through a grill. Within the grill is a damper, enabling the passenger to shut off the flow of air or turn it one as he wishes. The change of air is brought about by a suction created by ventilators placed on the roof of the car, fitted against the car monitor and having connection with the interior of the car through the openings ordinarily fitted with the deck sash.

Large openings in the ventilators face toward either end of the car. The motion of the car forces the air into one opening or the other, according to the direction which the car is moving, as a right angle bend in the duct conveys the air outward and away, leaving the ventilator by openings at the outer edge of the roof.

New Heating and Ventilating Systems for Chicago's Trolley Cars

Chicago is to have the best ventilated street cars and elevated railway trains in the country as the result of an agreement signed by Health Commissioner Evans, on behalf of the city, and the presidents of the various street railway and elevated roads.

The installation of new ventilating devices on the elevated roads will begin at once, and by the first of the new year it is expected that all trains will be thoroughly equipped. On the surface lines 700 cars are to be equipped with new ventilating systems as rapidly as possible. The new big cars now in use are better ventilated than cars in most other cities, and with the installation of the new ventilators will surpass any other street car system in the United States.

Various devices are to be used by the different transportation companies, including electric heaters. On the North and West Side lines the device to be installed is entirely new, and the invention of one of the company's own engineers.

It is proposed to maintain a temperature in the cars of not less than 45° and not more than 65° F. between October 15 and April 15 of each year.

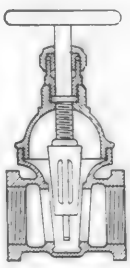
Trade Literature

Buckeye Portable Threading Machines or die stocks for pipe, are the subject of a newly-issued circular calling attention to the distinctive features of these devices, such as the short cutting edge of the dies, their adjustability, automatic release, die leading device and cutting off attachment. The dies are sold by the Gurney Heater Mfg. Co., Boston, Mass.

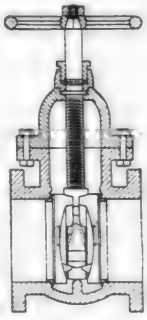
About Packless Valves is an interesting circular published by the Lavigne Mfg. Co., Detroit, Mich., manufacturers of the Lavigne graduated packless valve. A frequent complaint in connection with vacuum heating installations is the leakage of air around the valve stems, largely offsetting the work of the pump. The Lavigne packless valve is designed to overcome this difficulty. On account of its quick-opening feature, the valve can be fully opened or closed and locked closed by less than one-half turn. The circular includes sectional views showing the quick-opening, self-locking and foolproof features. "Twentieth Century Radiator Valves" is another circular published by this company, in which are described its various types of radiator valves, including the Lavigne quick-opening hot water radiator valve, with bell-shaped and globular bodies; screw stem steam radiator valve; corner radiator valve, and union elbows. Pp. 16. Size, 3½ x 6¼ in. (standard).

Modern House Heating is the title of the 1909 price list of the Gorton side-feed boilers, made by the Gorton & Lidgerwood Co., 96 Liberty street, New York. The trade will find this new price list of more than usual interest. It will be noticed that the line of Gorton side-feed boilers has been increased up to 34 sizes, ranging in capacity from 390 to 6,000 sq. ft. for steam and corresponding capacities for hot water. This, with other improvements, furnishes strong grounds for the published claim that this line is now one of the most complete on the market. As already noted in these columns, the Gorton & Lidgerwod Co. now guarantees the published ratings of its boilers, and this guarantee is prominently displayed in the new catalogue. Copies of the catalogue and price list will be furnished those asking for it. Pp. 24. Size, 4¼ x 6¼ in.

Gate Valve Design, by Carlisle Mason, is an interesting pamphlet, published by the Nelson Valve Co., Chestnut Hill, Philadelphia, Pa., in which are discussed the advantages of solid wedge versus double discs. After calling attention to the rigidity of the single, solid, tapered wedge type of valve, which allows no compensation for expansion and contraction strains, shocks or sagging of the pipe line, the writer traces the development of the double parallel disc type by which flexibility was gained by the use of two parallel discs, two parallel seats and self-adjusting spreading mechanisms of various kinds. In operation, when the discs are opposite the port their travel is retarded by an imposed obstruction that automatically expands the spreaders, forcing a lateral movement of the discs against the seats, and, under favorable conditions, closing the valve. The dis-

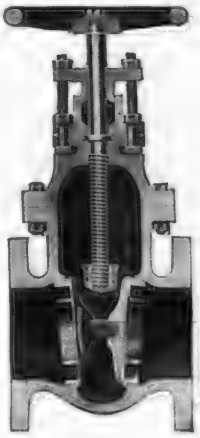


One tapered wedge fitting an angle made by the seats in the valve body.



Two parallel discs, two parallel seats, and self-adjusting spreading mechanism.

advantages of this type are stated to be that in accommodating the spreading devices, larger recesses are required, necessitating wider face-to-face dimensions and exposing a larger area of metal to the destructive elements. The double



INTERNAL VIEW OF TAPERED DOUBLE DISC BRONZE GATE VALVE

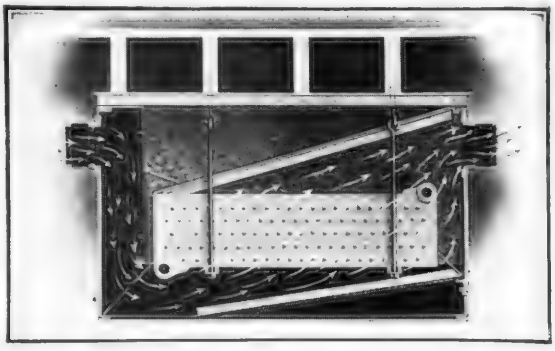
disc taper seat type, as made by the Nelson Valve Co., is designed to overcome the defects mentioned. The double disc mechanism consists of three parts, two tapered discs and one central wedge. The discs, without any other spreading device than the simple wedge on which they are carried, automatically rock into any position required for perfect seating,

whether the valve is in a horizontal or inclined position or when vertically placed. Another advantage mentioned for this type of valve is that it can be reground either on or off the pipe line. Pp. 12. Size, 3½ x 6 in.

Dunham Vacuo-Vapor System of Heating is explained and illustrated in a convincing manner in a new catalogue published by the National Vacuum Heating Co., Marshalltown, Ia. The principle of operation of this system is taken up at length in plain language devoid of technical terms so as to be readily understood by the layman as well as by the engineer. The Dunham vacuo-vapor system withdraws the water and air from the radiators and pipes by means of suction, created by a vacuum at the discharge end of the system. The escape of steam through the discharge pipes is prevented by a trap which passes air and water but closses against steam. The suction is obtained by means of a large tank located immediately over the boiler which is automatically and intermittently filled with steam. The condensation of steam in this tank produces the vacuum. The third essential device of this system, as explained in the catalogue, is an automatic vacuum air valve by which the air in the system is exhausted. Among the illustrations is one showing in detail the operation of the vacuum tank and air valve. Pp. 40. Size 6 x 9 in. (standard).

How to Utilize Exhaust Steam is the sub-title of a catalogue of the Cochrane open feed water heaters which has just been issued by the Harrison Safety Boiler Works, 3189 North 17th Street, Philadelphia. The title is fully justified by the fact that fully two-thirds of the book is occupied by discussions and illustrations of the different ways of employing exhaust steam, as for heating, drying, evaporating, heating water for boiler feeding and for use in dye works, tanneries, bleacheries and paper mills, etc. In a chapter entitled "The Possibilities of a Pound of Steam," it is pointed out that at the best only 10 per cent. or 12 per cent. of the total heat energy in steam can be converted into mechanical work, and that the remainder still present in the exhaust of an engine or turbine is as good for most of the purposes for which steam is employed as is the same weight of live steam. In a chapter on "Condensing Plants," it is shown that it does not pay to instal electric- or power-driven auxiliaries as long as the steam from steam-driven auxiliaries can be used for heating the feed water. The section on "Corrosion," gives the latest results, showing that air in solution in the water is a necessary condition to corrosion and pointing out that a large part of this can be driven off from the water by spraying the latter through a steam bath, as in the Cochrane open heater. The book is distributed gratis to those interested in steam plant matters. Pp. 104. Size 6 x 9 in.

Pennsy Patented Knock Down Indirect Radiator Casing, designed for use with all kinds of indirect radiation, and made by the Pennsylvania Furnace and Stove Co., Warren, Pa., is described in a catalogue issued by this company. The casings, which are made of galvanized iron, are neither bolted or riveted, but have



INSTALLATION OF PENNSY INDIRECT RADIATOR CASING

tight fitting grooves held in place by turn clips. They are shipped "knocked down." Air outlets are made of the proper size for each size of radiator, and the air can be admitted at either side, front or bottom. These casings are sold by the foot. Pp. 12. Size, 5½ x 8 in.

Vacuum Ventilator, manufactured by the Vacuum Ventilator Co., 82 Purchase Street, Boston, Mass., is an interesting device described in a new catalogue issued by the company. The "Vacuum" ventilator is of the shape of a hollow ball with a vertical outlet for the escape of the foul air, etc. The wind strikes the ball, the round sides being designed to send it over the opening. It thus sucks out the air which is in the ball causing a partial vacuum. This acts to draw up the air from within the building. Among the advantages mentioned for this type of ventilator are that it has no mechanical parts, there is no swinging or rotating in the wind, with no noise, friction or glass to break. Price lists are given for ventilators with barrels from 2 to 72 in. in diameter. Pp. 10. Size 3½ x 6 in. (standard).

Shirley Boilers, for steam and hot water heating, are the subject of a new booklet issued by the Shirley Radiator & Foundry Co., Indianapolis, Ind. The catalogue shows both the round boilers and the square sectional types, with side feed. Pp. 20. Size 3½ x 6 in. (standard).

TRADE AND MISCELLANEOUS NOTES

Coming Events

December 7-10, 1909.—Annual meeting of the American Society of Mechanical Engineers, New York. Headquarters at the Engineering Societies Building, 29 West 39th street, New York.

January 18, 19 and 20, 1910.—Annual meeting of the American Society of Heating and Ventilating Engineers, Engineering Societies Building, New York. Headquarters at the New Grand Hotel, Broadway and 31st street, New York.

Deaths

William D. Hartupee, president of the Pittsburg Valve & Fittings Co., Barberton, O., died in Pittsburg, September 23. He was 54 years old. Mr. Hartupee was for many years prominently identified with the plate glass industry. Later he organized the Pittsburg Valve & Fittings Co., of which he was made president.

John Hardin, president of the John Hardin Co., Chicago, dealers in heating and plumbing supplies, died September 22. He was 51 years old. He had been engaged in the heating and plumbing business in Chicago since 1880. He leaves a widow, three daughters and one son.

Miscellaneous Notes

Eastern Supply Association, at its annual meeting in New York, October 11, elected the following officers for the ensuing year: President, P. M. Beecher, Syracuse, N. Y.; first vice-president, John A. Murray, New York; second vice-president, F. H. Locke, Boston; treasurer, F. A. Bucknam, New York; secretary, Frank S. Hanley, New York. Board of directors: P. M. Beecher, John A. Murray, F. A. Bucknam, J. P. Fell, Buffalo; John Mitchell, Washington, D. C.; J. McClure Chase, Philadelphia; John McPhail, Baltimore; Walter Walls, Philadelphia; W. L. Blake, Portland, Me.; and G. R. Adams, Rochester, N. Y.

San Francisco, Cal.—Building operations for September are reported to be $1,724,983. This brings the total amount of building contracts since the fire to $143,866,945.

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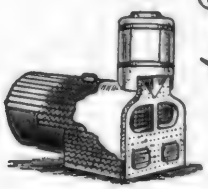

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Galesburg, Ill.—Negotiations are reported for a new heating and lighting plant for Galesburg with a capacity sufficient to supply the entire city with heat and light. The new company will compete with the McKinley syndicate of that place for both commodities.

Crawfordsville, Ind.—The new central station hot water heating plant was formally inaugurated October 13.

Sturgeon Bay, Wis.—On petition of a number of business firms who agreed to advance the necessary funds, the municipal heating system will be extended 1,000 ft. on Cedar street from Pine street. The petitioners will receive credit in heat for the money advanced, at the rate of 20c. per square foot of radiation the first year and not to exceed 18c. per square foot of radiation for the following four years.

Freeport, Ill.—Moline Plow Co. will build a new steam plant to heat its buildings on the river front. The new power house will be located in the rear of the present quarters.

Monmouth Public Service Co., Monmouth, Ill., will shortly have its new central station heating plant in operation. The power houses formerly owned by the Maitlands are being remodeled by the Schott Engineering Co., Chicago, for the accommodation of a much larger plant.

Winnipeg, Man.—A franchise is being sought to establish a central station heating plant in Winnipeg. A. J. Andrews, of that city, is representing the heating interests.

Building operations for September showed a substantial increase in all sections of the country over those of a corresponding period a year ago. The Eastern cities reported an increase of 11%; Middle West, 28%; Southern, 29%: Pacific Coast, 65%.

McMinnville, Ore.—W. E. Wright has been granted a franchise to operate a central station steam heating plant in that place. The plant is in course of construction.

Modern Science Club, 125 So. Elliott St., Brooklyn, N. Y., makes the following announcements for the remaining Tuesdays in November: Nov. 16, illustrated paper on "Globe, Gate and Check Valves," by Russell Bonnell, of the Nelson Valve Co.; Nov. 23, "The Use of Incandescent Lamps in Illumination," by B. F. Fisher, Jr., of the Westinghouse Electric & Mfg. Co.; Nov. 30, "Water Storage for Power in the Adirondack Mountains," illustrated, by William T. Donnelly.

Central Supply Association, at its annual meeting at the Southern Hotel, St. Louis, Mo., October 27, elected the following officers for the ensuing year: President, Frank Collins, Toledo, Ohio; first vice-president, George H. Gorton, Kansas City, Mo.; second vice-president, P. J. Frey, Minneapolis; treasurer, E. F. Niedecken, Milwaukee; secretary, Paul Blatchford, Chicago; executive committee, John D. Hibbard, J. B. Rahm, H. L. Andrews and S. H. Moon; national committee, John D. Hibbard, H. L. Andrews, H. M. Hoelscher, F. D. Keeler and Frank Collins; alternates, Alexander B. Pierce, George W. Ryan, J. F. Wolff, A. Y. McDonald and A. Markel.

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STEAM ENGINES. By Walter S. Leland and Walter B. Snow. 176 pp., 63 illus. Cloth binding. A concise, practical manual for the use of Engineers, Firemen, Machinists, Oilers and Shopmen in general. The principles of operation; types of engines fitted for different kinds of work; the steam turbine, multiple-expansion engines and engine accessories. Price.....**$1.00**

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Steam, the monthly publication devoted to the interests of the steam trade, has been purchased from the Gage Publishing Co. by the Ferguson Publishing Co., 114 Liberty street, New York, and will be published under the latter name, beginning with the current number. The architects' and automobile edition of The Buyers' Reference has also been purchased by the Ferguson Publishing Co.

George E. Downe, for 13 years manager of the boiler department of the American Radiator Co., Chicago, has resigned from that company. He has not yet announced his plans for the future, but it is understood that he will continue to be identified with the heating trade. Mr. Downe was the principal organizer of the Ideal Boiler Co., which made the original Ideal boilers. This company was taken over by the American Radiator Co. in 1896 and Mr. Downe was given charge of the boiler department which in the intervening period has shown remarkable growth. Mr. Downe first become prominently connected with the heating trade in 1887, when, in company with his brother, Henry S. Downe, he organized the National Hot Water Heater Co. to acquire the manufacturing rights of the Spence hot water heaters, which were at that time made by Worden-King & Son, of Montreal, Canada. Mr. Downe was elected president and general manager of the company.

In 1892 he was prominent in the formation of the American Boiler Co. which was a combination of Pierce, Butler & Pierce Mfg. Co., Richardson & Boynton Co. and the National Hot Water Heater Co. Mr. Downe was elected vice-president and general manager of this combination. It was a short-lived one, however, for Mr. Downe retired from the concern the following year and the various companies included in the combination resumed their individuality.

Ohio Society of Mechanical, Electrical and Steam Engineers held its twentieth meeting at Lima, Ohio, November 19 and 20. Headquarters were at the Lima House and the professional sessions were held in the auditorium of the Y. M. C. A. building. The papers presented included the following: "Power Costs for Factories," by President F. W. Ballard; "The New Laboratory of the Department of Mechanical Engineering at the Ohio State University," by Prof. E. A. Hitchcock; "The Darling Oil Gas Producer," by A. B. Davis; "Turbine Pumps," by Wetmore H. Titus, and "Some Notes on Coal and Ashes Handling Equipment," by David Gaehr.

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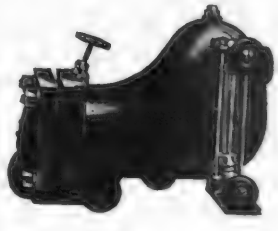

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Manufacturers' Notes

American Radiator Co., Chicago, according to reports, will build a new plant at Birmingham, Ala., with facilities for manufacturing boilers as well as radiators. The present leased plant turns out radiators alone. The proposed new plant will employ 1,500 men and will supply territory south of the Ohio.

Virginia Blower & Heater Co., Richmond, Va., has increased its capital stock to $10,000, and has removed to larger quarters at Fifteenth and Brown streets, Richmond.

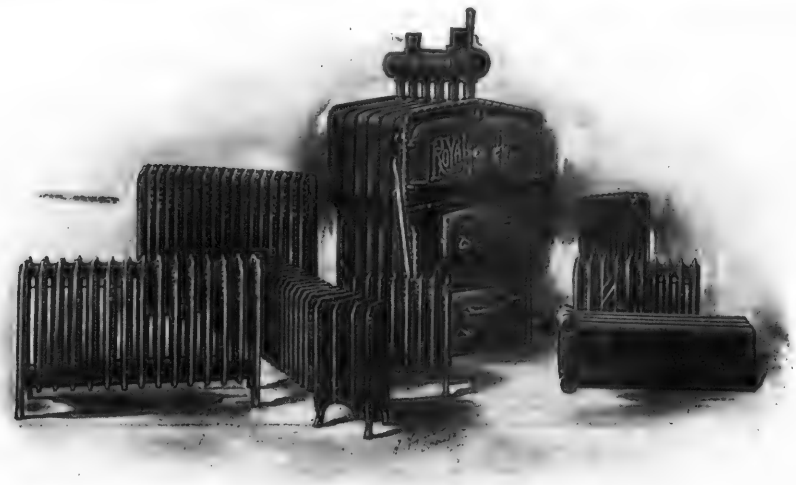
Detroit Valve & Fittings Co., Detroit, Mich., will build a $50,000 plant at Wyandotte, Mich., for the manufacture of brass, malleable and cast iron fittings. The equipment will include much new machinery.

Chapman Valve Mfg. Co., Springfield, Mass., announces the election as its president and general manager of Adolph W. Gilbert. Robert Shirley has been appointed works manager and engineer. Others who have recently become associated with the company in its manufacturing department are Edward O. Davis and John Busch.

Crane Co., Chicago, has suspended work on its large new plant at Oakmont, Pa., and has recalled its local engineers and managers to Chicago. This plant was supposed to be for the use of the consolidated interests of the Crane Co. and the Best Mfg. Co., of Pittsburg. It is reported that this proposed consolidation was never actually consummated, but has always been a tentative one. The plant on which work has been suspended already represents a heavy investment, and it is thought probable that it will be finished by Crane Company in the spring.

Hawley Down Draft Furnace Co., Chicago, Ill., is involved through a bill filed in the Superior Court asking that a receiver be appointed to take over the affairs of the $500,000 company. William Bleyer, a cousin of Charles E. Bleyer, president of the company, is said by the latter's son to be the cause of the bill. It is said that the proceedings were instituted by stockholders who hold less than 4% of the capital stock of the firm. Extravagance and mismanagement are charged.

United States Radiator & Boiler Co., West Newton and Corry, Pa., announces the manufacture of a hot water boiler, using gas exclusively for fuel. It will be known as the Sun gas fired water boiler and will be made for capacities ranging from 250 to 5,000 sq. ft. radiation.



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Chamberlain Metal Weather Strip Co., Detroit, Mich., announces the appointment of H. W. Whitten as manager of the Boston territory, in addition to his duties as the company's chief engineer. The company is sending to those asking for it an interesting device of celluloid for use in calculating the reduced amounts of radiation made possible by the use of Chamberlain metal weather strips.

Royal Heater Co., Gardner, Mass., will build a new factory at that point 32 x 88 ft. and two stories high. Plans have been drawn and construction will begin at once.

National Vacuum Heating Co., Marshalltown, Ia., is building a new $35,000 plant which the firm will occupy in the spring.

Garner Ventilating Co., Chicago, announces the appointment of H. B. Shontz as manager of its New York branch at 140 Liberty Street.

Pierce, Butler & Pierce Mfg. Co.'s new offices and showrooms at Fourth avenue and Twenty-second street, New York, are attracting much attention on account of their handsome appearance and the elaborate display of heating and plumbing goods for which ample room is provided. Included in the display of heating goods are some of the company's new American sectional boilers with the interior painted red, showing clearly the construction and the course of the gases. Other apparatus shown in position are various types of Pierce radiators, Modern boilers, Touraine round horizontal sectional boilers, Spence boilers, Giant water heater connected with a hot water storage tank, and Florida steam and hot water boilers. E. C. Molby is again at his desk in the company's new quarters after a prolonged illness, while the showrooms are under the immediate charge of Clarence C. Mulford.

New Incorporations

Scientific Heater Co., Cleveland, O. Capital stock, $10,000. Incorporators: Otto J. Kuenhold, Otto F. Schowalter, Lavine V. Schowalter and Wheeler W. Bush.

Glenn Plumbing Co., Dayton, O., capital $10,000, to take over business of Glenn & Schmidt. Incorporators: V. E. Glenn, Arthur F. Weber, Albert L. Pease, B. J. Farrell and George W. Ozias.

Apgar Plumbing & Heating Co., Elizabeth, N. J. Capital stock, $10,000. Incorporators: Andrew M. Apgar, Nathan A. Apgar and John F. Rogge, all of Elizabeth.

John P. Ley Co., capital $10,000, to deal in heating specialties. Among the principals is Walter Richards, of Brooklyn.

New York & New Jersey Furnace Co., Cranford, N. J., capital $100,000, to manufacture steam boilers and furnaces. Incorporators: Geo. H. Bates, Cranford; and Daniel H. Chinery and John M. Braisted, both of Port Richmond, N. J.

Morgan Vacuum Valve Co., Rochester, N. Y., to manufacture a patented vacuum valve.

Frontier Boiler Mfg. Co., Buffalo, N. Y., capital stock $100,000, to manufacture boilers, tanks, stills and structural steel and plate work. President, A. B. Douglass, formerly of Farrar & Teffts; secretary and treasurer, Henry A. Bittner. The company will occupy the plant of the American Bridge Co., at Bailey avenue and Pennsylvania Railroad.

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American Ventilating Co., Bridgeport, Conn., capital $50,000, to deal in heating and ventilating, hardware, plumbing and metal supplies, and to conduct a contracting business. Incorporators: Claude V. Burdick, Ernest G. Abernethy and Charles K. Williams, all of Bridgeport.

Manning Plumbing Co., Spokane, Wash. Capital stock, $30,000.

B. Fanning Co., Rochester, N. Y., capital $20,000, to conduct a heating and plumbing business. Incorporators: Benjamin Fanning, Newark, N. Y.; and John F. Snow and Eugene M. Strouss, of Rochester.

Vacuum Car Ventilating Co., Chicago, capital $150,000, to manufacture vacuum ventilating machinery and appliances. Incorporators: E. B. Kittle, William H. Gruver and Paul Brown.

Barr & Creelman, Rochester, N. Y., capital $100,000, contractors for heating, ventilating, plumbing, gas and electrical work. Incorporators: J. A. Creelman, W. J. Creelman, of Rochester; and H. B. Fairman, of Victor.

Thomas J. Douglass & Co., Chicago, capital $10,000, to conduct a heating and plumbing business.

Pacific Heating & Plumbing Co., Seattle, Wash. Capital stock, $25,000. Incorporators: A. H. Chriman, O. T. Nelson, J. Mac Isaac and D. Blesser.

Turner & Van Scoy Co., Wilkes Barre, Pa., capital $10,000, to take over the heating and plumbing business of Turner & Van Scoy.

Carthey & Dumbeck, Salt Lake City, Utah, capital $24,000, to conduct a heating and plumbing business. President, F. G. Carthey; vice-president and manager, R. Dumbeck; secretary and treasurer, R. F. Carthey.

Fort Wayne Brass Works, Fort Wayne, Ind. Capital stock, $15,000. Directors: Maurice Goldberger, J. H. Mandeville and William J. Vesey.

New Firms and Business Changes

Handy Mfg. Co., Bridgeport, Conn., is a new firm organized to manufacture the Handy die stock. The company will maintain its factory at Bridgeport, and its main offices are located in New York, at 71-73 West Broadway. The principal interests in the firm are held by H. S. Ashmun, formerly of the Connecticut Tool Co., of Bridgeport, and Paul Becker, formerly with the Armstrong Mfg. Co., the former having charge of the New York office, while Mr. Becker handles the manufacturing end at Bridgeport.

F. G. Sanford & Co., Yonkers, N. Y., contractors for steam and hot water fitting, have opened an office at 314 Main street, Yonkers. The firm is composed of F. G., M. E. and H. W. Sanford. F. G. Sanford was formerly connected with A. B. Barr & Co., of Yonkers.

Ware & Broadbent, Toledo, O., is the new title of the heating and plumbing firm of Ware & Moodie, of which the late R. B. Moodie was president. Mr. Broadbent is a stepson of Charles Ware, who is the senior partner, and has been connected with the business for several years.

Thomas F. Cushing Co., 453 West 125th street, New York, jobbers of heating and plumbing supplies, has announced its retirement from business. Thomas F. Cushing was president and treasurer of the company.

Contracts Awarded

McConnel Plumbing Co., Pratt, Kan., heating and plumbing court house and jail at Pratt, for $5,946.

W. A. Bowers Heating Co., Milwaukee, Wis., heating and plumbing new $20,000 power house and central station heating plant at the Normal School at Stevens Point, for $5,493.

Lewis & Kitchen, Kansas City, Mo., heating and ventilating high school building at Hutchinson, Kan., for $17,544. Holbrook & Martin, Atchison, have the plumbing contract at $7,067.

Baker, Smith & Co., New York, mechanical equipment of the new building

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for the Prudential Insurance Co. at Newark, N. J. The contract is one of the largest of its kind that has been let in the metropolitan district for some time, amounting, without the engines, to about $400,000.

American Warming & Ventilating Co., Pittsburg, heating and ventilating new annex of the high school building at Washington, Pa., for $6,250.

Arthur McGonagle Co., New York, vacuum steam heating system for loft building of the Theodore E. Hergert Co., on East Fifty-third street, New York. Fourteen thousand square feet of Kinnear pressed radiation will be used.

Robert W. Kyle Co., Wheeling, W. Va., heating new city building, by low pressure steam, for $3,550.

John G. Sutton Co., San Francisco, Cal., heating and ventilating Sheridan School, for $11,882. American Air Cleaning Co. will install a vacuum cleaning system at its bid of $850.

Aetna Heating Co., New Britain, N. J., heating and ventilating high school building at Rahway.

O. S. Kendall & Sons, Worcester, Mass., steam heating Children's Institute Department of Clark University.

American Warming & Ventilating Co., Pittsburg, Pa., heating system for new 13-story Frick Building on Highland avenue, East Side, Pittsburg; also heating and ventilating annex of Washington (Pa.) school, for $6,250.

John Bishop, Salina, Kan., heating and plumbing systems at the Dodge City Soldiers' Home. The contracts aggregate $22,000. The heating system will include a central plant connecting to the various buildings.

Weiland & Senn, Marshfield, Wis., heating and plumbing Adler Block at that place. Three thousand five hundred square feet of radiation will be installed.

Becker-Seidel Co., Cleveland, O., heating Warrensville farm colony at Warrensville, for $7,134.50.

Elizabethtown Hardware Co., Elizabeth, N. Y., heating and plumbing plant for Garondah, the country residence of Erman J. Ridgway. The contract amounts to over $3,000.

Downey & Kruse Co., Milwaukee, Wis., heating new Detention Home, for $9,436.

John B. Hughes Heating Co., Leavenworth, Kan., heating and ventilating new hospital at the Federal prison, for $7,815.

T. J. Mooney & Co., Nashville, Tenn., heating and plumbing new Y. M. C. A. building at Nashville.

E. W. & F. R. Webster, Dubois, Pa., heating, ventilating and plumbing for the Titusville Trust Company's building, which is being enlarged. The contract amounts to $29,783. Work commenced November 1.

Storms & Co., Newark, N. J., heating new laundry building at the Overbrook Insane Asylum, for $2,634.

Brice Heating & Ventilating Co., Toledo, O., heating new Mishawaka High School at South Bend, Ind., for $11,000.

Healy Co., St. Paul, Minn., was the lowest bidder for the heating and plumbing of a civilian teamsters' quarters at Fort Russell, at $4,988.

Lennig-Rapple Engineering Co., San Francisco, Cal., heating and ventilating

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new Odd Fellows' building, for $5,200; also heating and power piping in new 10-story office building for Mrs. Sanders, for $6,000.

Kehm Bros. Co., Chicago, heating Chicago & Northwestern Railroad's new $20,000,000 terminal station in Chicago. The Van Auken system will be used.

Baker, Smith & Co., Pitsburg, Pa., steam heating and ventilating new $500,000 high school at Pittsburg, for $30,000.

Thomas Haverty Co., Los Angeles, Cal., steam heating and plumbing Utah Hotel Co.'s new hotel at Salt Lake City, for $100,000.

Chappelle & Warren Co., Cleveland, O., heating and ventilating new annex to the Willard School in that city.

Marshall & Hufcut, Pleasantville, N. Y., heating and ventilating new high school at Pleasantville.

Business Chances

Washington, D. C.—Sealed proposals will be received at the office of the Supervising Architect, Treasury, for the following-named work:

Until Nov. 18, 1909, for the construction (including plumbing, heating, wiring and standard clock system) for the extension to the U. S. Post Office at Rock Island, Ill.

Until Nov. 24, 1909, for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of an extension, remodeling, etc., to the U. S. Court House, Post Office, etc., at Montgomery, Ala.

Until Nov. 26, 1909, for the heating apparatus at the U. S. Post Office and Court House and extension thereto at Council Bluffs, Ia.

Until Dec. 2, 1909, for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of an extension, remodeling, etc., to the U. S. Post Office at New Brunswick, N. J.

Until December 6, 1909, for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring), of an extension, remodeling, etc., to the U. S. Post Office at Hot Springs, Ark.

Until December 15, 1909, for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of an extension, remodeling, etc., to the U. S. Post Office and Court House at Davenport, Ia.

Until December 18, 1909, for the power plant, including boilers, engines, electric generators, switchboard, conduits, wiring, heating and ventilating apparatus, deep well, deep well pumps and vacuum cleaning system for the U. S. Custom House and Appraisers' Stores buildings at San Francisco, Cal.

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Baldwin on Heating; or Steam Heating for Buildings. By William J. Baldwin. Fifteenth edition. Revised and enlarged. 391 pages. 131 figures. Size, 5x7½ in. Contains descriptions of steam heating apparatus for warming and ventilating large buildings and private houses, with remarks and tables. Cloth, $2.50, or the book and one year's subscription to THE HEATING AND VENTILATING MAGAZINE, $3.25.

Questions and Answers on the Practice and Theory of Steam and Hot-Water Heating. By R. M. Starbuck. Illustrated. $1.00; or the book and one year's subscription to THE HEATING AND VENTILATING MAGAZINE, $1.75.

The Ventilation of the Schoolroom. By William J. Baldwin. Price, $1.00; or the book and one year's subscription to THE HEATING AND VENTILATING MAGAZINE, $1.75.

Ventilation of Buildings. By William G. Snow and Thomas Nolan. 83 pages. Pocket size. Contains a statement of the general principles of ventilation and of their application to different kinds of buildings. Boards, 50c.; or the book and one year's subscription to THE HEATING AND VENTILATING MAGAZINE, $1.25.

Steam Heating and Ventilation. By Wm. S. Monroe. Containing formulas and data valuable in the designing of heating and ventilating plants. Price, $2.00; or the book and one year's subscription to THE HEATING AND VENTILATING MAGAZINE, $2.60.

Air-Conditioning. By G. B. Wilson. Being a short treatise on the humidification, ventilation, cooling and the hygiene of textile factories—especially with relation to those in the U. S. A. With figures. 12mo. Illustrated. 143 pages. Price, $1.20; or the book and one year's subscription to THE HEATING AND VENTILATING MAGAZINE, $2.00.

Steam-Electric Power Plants. By Frank Koester. A practical treatise on the design of Central Light and Power Stations and their economical construction and operation. 473 pages. 340 ills. Price, $5.00; or the book and one year's subscription to THE HEATING AND VENTILATING MAGAZINE, $5.25.

Light, Heat and Power in Buildings. By Alton D Adams, M. E. The purpose of this volume is to present in compact form the main facts on which selection of the sources of light, heat and power in buildings should be based. The problem is to determine the kind of equipment that will yield the service required at the least cost. 12mo. Cloth, $1.00; or the book and one year's subscription to THE HEATING AND VENTILATING MAGAZINE, $1.75.

Practical Steam and Hot Water Heating. By Alfred G. King. Containing over 300 detailed illustrations. The book is a working manual for heating contractors, journeymen steam fitters, architects and builders. Describes various systems of heating and ventilation and includes useful data and tables for estimating, installing and testing such systems. 8vo. 367 pages. Price, $3.00; or the book and one year's subscription to THE HEATING AND VENTILATING MAGAZINE, $3.25.

Power, Heating and Ventilation. By Charles L. Hubbard, B.S., M.E. A treatise for designing and constructing engineers and architects. The whole subject of heating is covered, including the heating of large institutions with central plants. Space is also devoted to electrical matters connected with steam plants. 647 pages. Price, $5.00 (three volumes in one); or the book and one year's subscription to THE HEATING AND VENTILATING MAGAZINE, $5.25.

Notes on Heating and Ventilation. By John R Allen. 152 pages. 34 illustrations. Size, 4¼x6½ in. One of the new books, brought quite up to date, and containing much information to guide the intelligent steam fitter in the installation and heating and ventilating apparatus. Cloth, $2.00; or the book and one year's subscription to THE HEATING AND VENTILATING MAGAZINE, $2.50.

Hot-Water Heating and Fitting. By W. J. Baldwin. Fourth edition. Price, $4.00; or the book and one year's subscription to THE HEATING AND VENTILATING MAGAZINE, $4.50.

Dean's System of Greenhouse Heating, by steam or hot water, with formulas for obtaining different temperatures, by Mark Dean. Price, $2.00; or the book and one year's subscription to THE HEATING AND VENTILATING MAGAZINE, $2.50.

Steam Fitters' Computation and Price Book, abridged. By Mark Dean. Price, $2.50; or the book and one year's subscription to THE HEATING AND VENTILATING MAGAZINE, $3.25.

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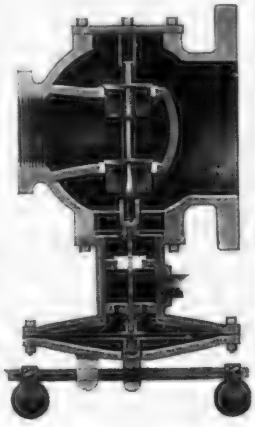

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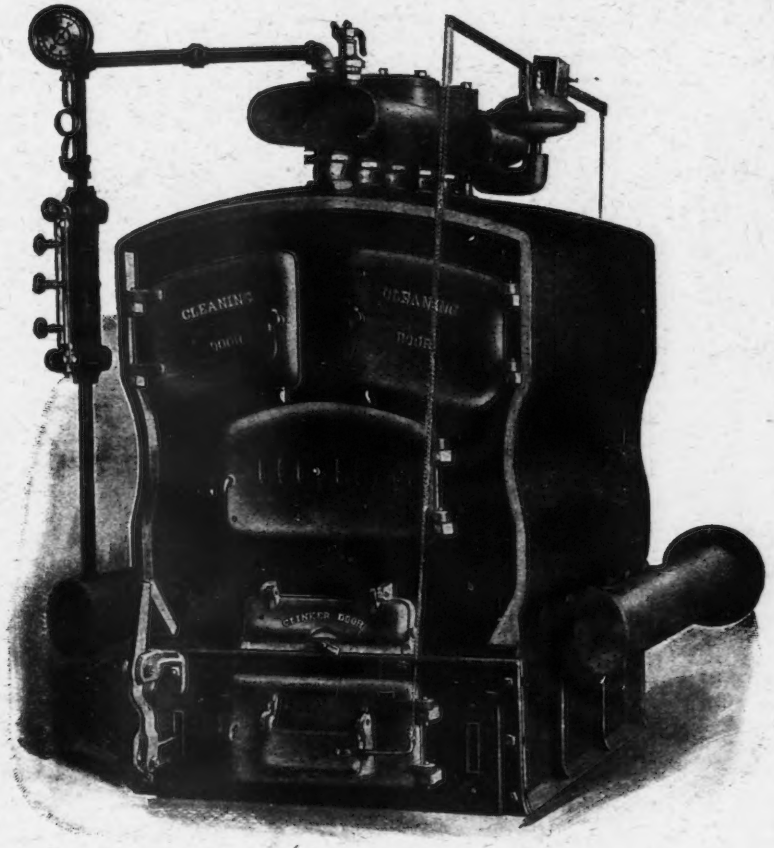

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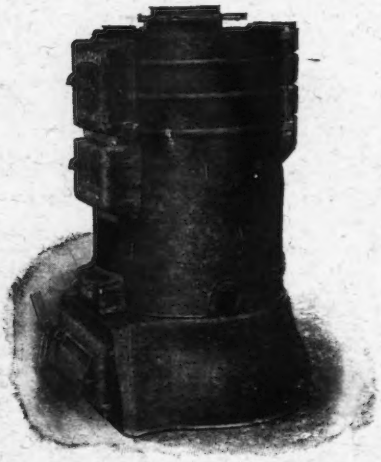

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